

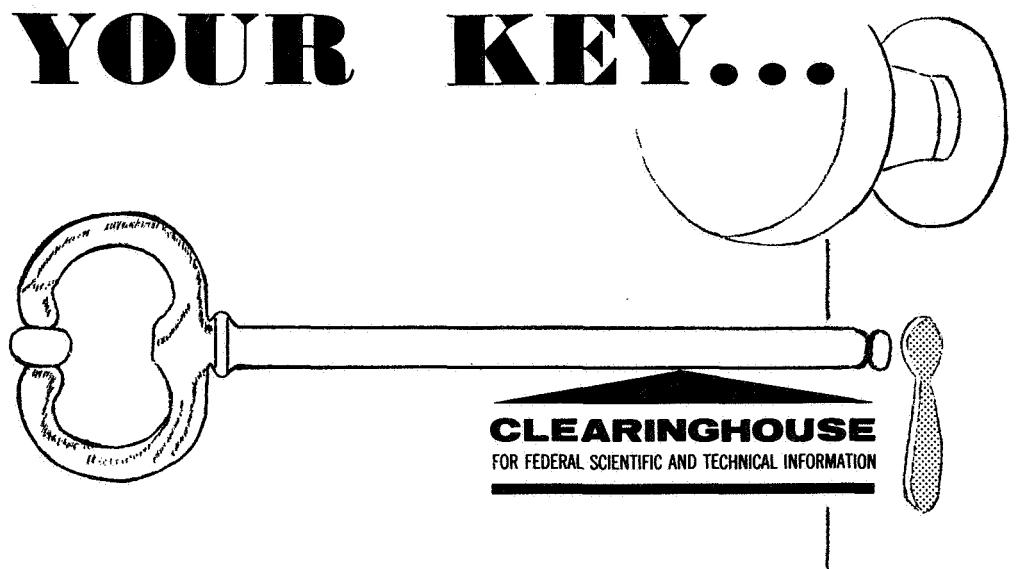
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PERIPHERAL VOLUME MEASUREMENTS AS INDICES
OF PERIPHERAL CIRCULATORY FACTORS IN THE
CARDIOVASCULAR ORTHOSTATIC RESPONSE

Loren D. Carlson, et al

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**PERIPHERAL VOLUME IN ACUTE TO MEDIUMS OF
PERIPHERAL CIRCULATORY SYSTEMS IN THE
CARDIOVASCULAR ORTHOTROPIC DEPRESSED**

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GENERAL INTRODUCTION

Classical "rest studies"¹, immobility and water immersion, and results of orbital space flight give rise to a set of clinical signs and syndromes which characterize a "deconditioning of the cardiovascular system". The principal measurements related to the "deconditioning" are the change in heart rate and blood pressure during passive tilt to a 70° from horizontal position. "rest" has proposed a number of different "measures" and derivatives of measures (a total cf 32) to characterize the responses but find's heart rate to be the best single indicator.

An alternative provocative test is the application of negative pressure to the lower portions of the body.²

There are a number of mechanisms which may give rise to the responses. Among these are a change in blood volume or a change in venous tone during passive tilt.

Each of these factors provides³ any data on a variety of parameters in time. These data are relevant to a quantitation of the response to an assessment of mechanism, and to an evaluation of medical measures.

This report is concerned with an evaluation of techniques of measuring changes in limb volume (part I) and an evaluation of this measure in assessing the deconditioning occasioned by bed-rest (part II).

¹This literature is reviewed in NASA CR-171, "the effect of bedrest on various parameters of physiological function," C. Valenka, P. B. Voel, F. Gareus, W. A. Spancer and J. Walters, 1965. See also Lamb, L. T., "Status of knowledge of weightlessness, 1965," Appendix 5, pp. 531-545, Space Research, Directions for the Future, NASA SP-134, 1965, p. 103.

²The principal references are given in Cumulative effects of venous bed rest, negative pressure, Raymond R. Murray, "D.", John "D.C.", Ph.D., Lorier, Carlson, Ph.D., and John A. Bowers, M.D., Aerospace Medicine, Volume 38, March 1967 (THE REFERENCES ATTACHED)

FRANCE: INT - references

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FIGURE DESCRIPTIONS - PART I

Figure

- I-1 Double stranded mercury in siliastic gauge.
- I-2 Double stranded gauge on calibrator stand. Tiltometer at right angles.
- I-3 Gauges mounted on cal^o of ler.
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- I-5 Parts list and drawing of proposed gauge design.
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PAPER I

Introduction

Non-invasive techniques for the measurement of blood flow by venous occlusion plethysmography involve direct or indirect measures of volume change of the extremity measured. In this study, three techniques were investigated: 1) limb circumference changes by a resistance transducer; 2) limb volume change by capacitance measurement; and 3) limb volume change by impedance measurement.

The resistance transducer for volume change, a circumference measurement, was introduced by R. J. Whitney (1953). The applications of the gauge have been described in detail by Fagan (1961) and the validation of the method documented by Burger, et al (1959 a,b) and by Clarke and Peltion (1957). The gauge, as described by Whitney, has a low resistance (0.1 to 8 ohms). A high impedance application has been devised by Waggoner (1965) introducing electrode paste in substitution for the mercury.

The physics of the strain gauge and the calculations for the gauge have been compiled by Fagan (1961). The fundamental considerations from that article are reproduced below.

Abbreviations

The symbols which will be used are listed below. Values applicable to a specific finger gauge, and to a typical finger, are given in square brackets, for some parameters.

- L = length of active portion of gauge (cm). [15 mm when $\tau = 10\text{ g}$]
r = radius of the bore of the tubing (cm). [$r_p = 0.35\text{ mm}$]
a = cross-sectional area of mercury column (cm^2)
v = volume of mercury in the gauge (units not required).
R = resistance of the mercury column (ohm). [$R_p = 0.45\text{ ohms}$]
 t = temperature of the mercury ($^\circ\text{C}$).
 T = tension in the gauge tubing (g). [10 g]
 F = pressure exerted radially by gauge upon the finger (see Fig.).
 P = longitudinal tension in finger skin required to support P (a).

Change in resistance with length

The volume of mercury in a column = $L \cdot a = v$

C = circumference of finger (cm). [50 mm]
 a = cross-sectional area of finger under the gauge (units not required).

v = volume of finger (units not required).

Δ = symbol used in logic, meaning "is equivalent to."
standard values that are used have been taken from the

Handbook of Chemistry and Physics (37th ed.).

Terminology

The volume (v) of the finger is the dependent variable in plethysmography. It is percentage change in volume (Δv), either per unit time or following the application of some procedure, which is most useful to physiologists. To convert this to the terminology commonly used in plethysmography:

$$\Delta v \leftrightarrow n \text{ cc/100 cc of tissue,}$$

(n = any number).

Resistance of Gauge

Resistance (R) of mercury = 95.79 microhm-cm, at 20° C.

$$\text{Resistance (R) of a mercury column} = \frac{(9.579 \times 10^{-5} \text{ ohm-cm})}{\text{cm}^2}$$

$$= \frac{F L}{a}.$$

$$R = \frac{9.578 \times 10^{-5}}{9.6 \times 10^{-7}} = 0.10 \text{ ohms/cm}^2. \quad (\text{meaning "ohms per cm of length"})$$

$$\text{Hence, for the gauge described } (L = 75 \text{ mm}), R = 0.45 \text{ ohms. (The measured resistance will be slightly greater since ID was measured with the tubing unstretched; under 10 g F, the area (a) is slightly less than the figure calculated above.)}$$

*Lawton and Collins (1959) have used rubber tubing of 0.5 mm ID, which works out to $R = 0.05 \text{ ohm/cm}$. Yet, they report "a resistance of about 0.23 ohm/cm" - a surprising discrepancy!

Change in resistance with tension

The volume of mercury in a column = $L \cdot a = v$

$$v = \frac{PL}{a},$$

$$= \frac{PL^2}{V} \quad (\text{top and bottom multiplied by L}).$$

$$\text{differentiating, } \frac{\partial P}{\partial L} = \frac{2FL}{V} \quad (\text{since } C \text{ and } V \text{ are constants}),$$

$$= \frac{2n}{L} \quad (\text{since } \frac{FL}{V} = \eta).$$

From this, it follows that:

$$18 \Delta L \leftrightarrow 2n \Delta R.$$

However, this is only approximately correct. The exact general relationship is given by:

$$n \Delta L = 2 n \Delta R + \frac{n^2}{a} + 1 \Delta R.$$

Temperature Coefficient of Resistance

The temperature coefficient of resistivity (α) of mercury = 0.00689, at 20° C. or at 20° C, $\Delta \gamma^\circ C = 8.9 \times 10^{-3} \times \alpha$.

$$\text{The } \Delta R^\circ C = \frac{8.9 \times 10^{-3} \times \alpha}{a} \times 100$$

$$= 8.9 \times 10^{-6}.$$

Now $18 \Delta L \leftrightarrow 2n \Delta R$. The temperature change (Δt) required to cause $2n \Delta R = \frac{2}{3.9 \times 10^{-6}}$

$$= 22.5^\circ C$$

Fence, $18 \Delta L \leftrightarrow 22.5^\circ C \Delta t$.

Change in tension with Length

"A gauge was suspended with 10-g tension (T) on it. The length (L) of the active portion was 45 mm. An additional 5-g tension was applied which stretched the gauge by 1.6 mm, as determined by the method of precise calibration (Eagan, 1961) which was being done concurrently."

$$\text{Hence, } 5 \text{ g} \cdot 1 \text{ ml} \rightarrow \frac{1.6}{45} \times 100 = 3.3\% \Delta C.$$

$$\text{Then } 1\% \Delta C \rightarrow \frac{3}{3.3} = 1.5 \text{ g A.T.}$$

(The relationship between ΔC and ΔV will vary according to the ID of the particular sample of tubing. ID is quite regular.)

Change in Volume of a Cylinder Related to Change in Circumference

The first section which follows is excerpted from Clarke and Fallon (1957). Consider a cylinder of radius r . Let the cylinder expand slightly in a radial direction only, so that the radius increases from r to $r + dr$.

$$\begin{aligned} \text{The change in area} &= \pi(r + dr)^2 - \pi r^2 \\ &= 2\pi r dr, \text{ if } dr \text{ is small,} \end{aligned}$$

$$\begin{aligned} \text{Percentage change in area} &= \frac{2\pi r dr}{\pi r^2} \cdot 100 \\ &= \frac{2 dr}{r} \cdot 100 \end{aligned}$$

$$\begin{aligned} \text{The change in circumference} &= 2\pi(r + dr) - 2\pi r \\ &= 2\pi dr \end{aligned}$$

$$\begin{aligned} \text{Percentage change in circumference} &= \frac{2\pi dr}{2\pi r} \cdot 100 \\ &= \frac{dr}{r} \cdot 100 \end{aligned}$$

Thus, the percentage change, or rate of change, of limb (or digital) circumference will be half the percentage change, or rate of change, of cross-sectional area (or volume).

Using the symbols we have applied for the finger:

$$\begin{gathered} 1 \Delta C \rightarrow 28 \Delta A \\ 4 \rightarrow 28 \Delta V \end{gathered}$$

This simple relationship is only approximately correct, but it will be shown that the error involved in using it is too slight to be of practical importance in plethysmography.

"The exact relationship between C and V is usually given by the formula:

$$\Delta V = \frac{2C \cdot \Delta C + (\Delta C)^2}{C^2} \cdot 100$$

"The use of this formula will give the appearance of slightly greater accuracy, though the extra work of calculation is usually unwarranted by reason of other possible errors in the plethysmographic method. If one is measuring blood flow in the finger, and following venous occlusion obtains $1\% \Delta C/\text{sec}$, then blood flow calculated by the formula becomes $2.01\% \Delta V/\text{sec} + 120.6\% /V\text{-min}$. However, there is a pitfall for the urinary plethysmographer who hopes for greater accuracy by using the formula, but who makes the assumption that it is C which changes linearly with time. This error can be "allen into" by assuming that $1\% \Delta C/\text{sec} = 60\% \Delta C/\text{min}$. Then, using the formula, blood flow would work out to $156\% \Delta V/\text{min}$ — a considerable error!

"It must be remembered that ΔV is closer to the changing physiological parameter than is ΔC . For instance, the actual progression of events relevant to venous occlusion plethysmography would be as follows: venous occlusion $\rightarrow \Delta V \rightarrow \Delta C \rightarrow \Delta L \rightarrow \Delta r \rightarrow$ stylus deflection, from which is calculated the rate of blood flow. The general progression of measurement is in the reverse, with error being possible at each transition.

"A simple formula which exactly delineates the relationship between ΔC and ΔV is:

$$\Delta V = 2 \Delta C \Delta V + \frac{\Delta C^2}{100} \Delta V$$

In finger plethysmography, ΔV will usually equal approximately 1% and will seldom be greater than 2% . Using this figure, $2\% \Delta C = 0.008 \Delta V$. With cognizance of the possible errors in all of the other steps in the progression of measurement mentioned above, it is evident that the 0.008 portion could be safely disregarded. Hence, in finger plethysmography, it can be assumed that $1\% \Delta C \rightarrow 28 \Delta V$.

"All of the previous calculations have been based on the cylinder and this share is presumed for the finger. Whitney (1955) has shown that there is negligible error in this assumption unless there is a very great deviation from the circular shape.

Relationship Between ΔV and ΔC

It has been stated previously that:

$$ns \Delta L = 2 ns / P + \frac{\pi^2}{160} s / R,$$

$$\text{and, } ns \Delta C = 2 ns / V + \frac{\pi^2}{160} s / R.$$

Now the relationship between ΔL and ΔC is one of exact linearity (since C and V are constants in any one experiment),

$$\text{viz., } ns \Delta C = \frac{C}{L} \text{ at } \Delta L.$$

$$\text{Hence, } ns \Delta V = \frac{C}{L} - ns \Delta R.$$

"Thus, in practice, all of the previous minor reservations that have been made concerning the use of the short mathematical form in describing the relationship between ΔC , on the one hand, and ΔV and ΔR , on the other, may be ignored entirely. The dependent variable is ΔV , and ΔR is what is measured. Their relationship is one of exact linearity in the case where L and C are equal. It has been shown that even on the assumption of a linear relationship between ΔC and ΔR , the error in using the equation, $ns \Delta C = 2 ns \Delta V$, was slight. It is now apparent that this relationship is exactly true when $L = C$, and so close to being correct when L makes up the greater part of C , that no error is involved in using it. (For example, if $\Delta C = 2.0$, $L = 45$ mm, and $C = 50$ mm, then $\Delta V = 3.996$, rather than the 4.0 which would derive from the simple equation.)

Thus, through a fortuity of nature, in the calibration of the mercury finger gauge, and in its use for plethysmography of the finger, it may be considered that:

$$ns \Delta C = 2 ns \Delta V$$

*This is true with the assumption that: (a) the length of the gauge changes with change in circumference without causing variation in the degree of deformation of the skin under the gauge; (b) changes in the thickness of the wall of the tubing between the mercury column and the skin are negligible.

Radial pressure exerted by the gauge

Gauge tension is about 1.25 mm, the pressure exerted by the gauge will be on a circular strip of the finger approximately 1 mm wide. Hence, $P = 9800 \text{ dynes/mm}^2 = 98,000 \text{ dynes/cm}^2$.

r of finger = 50 mm, so that the radius (r) = 0.80 cm. From the formula, $P = \frac{\pi r}{2}$ (where P is in dynes/cm², r in dynes/cm, and r in cm)

the radial pressure, $P = \frac{98,000}{0.80} = 122,500 \text{ dynes/cm}^2$. Since 1 mm Hg = 1330 dynes/cm², then $P = \frac{122,500}{1330} = 92 \text{ mm Hg}$. Since $16 \Delta C = 1.7 \text{ g} \wedge T$, then $T_1 = 11.7 \text{ g}$ and $P_1 = 108 \text{ mm Hg}$. Hence, $16 \Delta C = \frac{P_1}{16 \text{ mm Hg}} \Delta P$.

Support of the Gauge Pressure

The gauge may be supported by tension in the skin (T_s) acting longitudinally. From inspection, it was estimated that the radius of the "circle" of deformation of the skin = 1 mm, approximately. Since $P = 92 \text{ mm Hg} = 122,500 \text{ dynes/cm}^2$, then

$$P = P r = 122,500 \times 0.1 = 12,250 \text{ dynes/cm} \\ = \frac{12,250}{980} = 12.5 \text{ g/cm}.$$

Total longitudinal tension in the skin (T_q) of the finger of 5.0 cm $C = 5 \times 12.5 = 62.5 \text{ g}$. If 1% increase in C occurs, $T_1 = 11.7 \text{ g}$ and $T_{s,1} = 73 \text{ g}$, in order to support P_1 . Hence $16 \Delta C \rightarrow 10.5 \text{ g} \wedge T_s$. These are maximum figures for both T_s and ΔC ; the gauge P may be supported in part by tissues directly under the gauge.

In experiment was done to assess the relative importance of T_s . A light, latex rubber finger cot was sealed to the tip of the finger, circumferentially, 2 or 3 mm distal to the mercury gauge attached as described in ML-NY-60-15 (Regan, 1961). The finger was held with tip downwards. When 50 g was hung from the free end of the cot, an apparent increase in circumference of the finger equal to 0.25% / C was measured (average value). A 100-g weight gave an average of 0.5% / C . Hence, 1% $C \rightarrow 1200 \text{ g}$ of externally applied tension.

Tension applied externally to the surface of the skin at a few millimeter's distance from the gauge is not numerically comparable to that which exists in the skin (Rothman, 1954) and which could increase due to deformation caused by the radial pressure (P) exerted by the gauge. The fact that increasing the tension in the skin causes an apparent increase in C of the finger suggests that the gauge is supported at least in part by T_s . The remaining part would be supported by diffusion of the pressure gradient radially and laterally into the underlying tissue. The failure of any slow decrease in apparent C to occur in the finger, after the gauge under 10-g tension is attached, suggests that T_s is the important factor.

Calibration Equivalents

Static calibration of the finger gauge has been discussed in "AL-TR-60-15" (Ragan, 1961). A typical value obtained is 20.0-mm deflection on the record, with an AMPELUMATOR setting of X 100 (on the carrier preamplifier of the Sanborn 150 system), for 2.00-mm extension of the gauge. It follows that:

$$18.5 \text{ C} \leftrightarrow 5.0\text{-mm deflection, on X 100}$$
$$\leftrightarrow 150\text{-mm} \quad \text{X 10}$$

at the limit of resolution, a ΔC of 1 micron = 0.0024 $\Delta C \leftrightarrow 1$ mm of stylus deflection, on X 1.

A dynamic calibration of the gauge has been done by Layton and Collins (1958) using a variable-frequency, variable-amplitude vibrator. Since this work cannot readily be summarized, the reader is referred to the original. The frequency response characteristics of the gauge are such that they impose no limitations on its use in ordinary plethysmograph.

Resistance Transducers for Volume Change
Mercury and rubber gauge or Whitney gauge, as used in these experiments, is shown in Figure I-1. It consists of a double loop of 0.045" O.D. and 0.015" I.D. plastic tubing fixed to silver wires after being filled with mercury. Silver wire ends are fastened with the lead wires in a plastic block approximately 1 cm apart. The loop is carried around the leg and fastened on the semicircular plastic block and adjusted on the phosphorbronze strain of metal until the tension is equal to the 20 g tension used in calibration. Calibration stand is shown in Figure I-2 and gauge as mounted on the leg is shown in Figure I-3.

The gauges are stable. Tests over a sixty-minute period gave changes randomly distributed about zero and within the range -0.1228 \pm 0.0484 V.

Improvements for the gauge design are shown in the fabrication drawing with a materials list in Figure I-4, I-5.
The Question of Artifact and Error in the Use of the Whitney Gauge
The comparison of conventional methods and the strain gauge technique has been made by Clark and Leillon in 1957. This discussion of artifact and error will not negate the close correspondence of strain gauge method and conventional vena occlusion plethysmography but will indicate the pitfalls of the method when it is extended beyond the standard use in which it can be compared with a water- or air-filled plethysmograph. That is to say, the Whitney gauge can be installed and used during exercise and during tilt procedures and in these conditions it cannot be compared with water-filled apparatus.

Temperature induced errors in uncompensated gauges, such as have been used, will not be great under the conditions of the tilt table experiment. If room temperature is maintained so the subject is warm as to have a reasonable skin blood flow without sweating, the errors in temperature will be minimal. Measurements of the temperature of the leg do indicate slight shifts in temperature and an ideal gauge would include the temperature compensation circuit which was devised by Whitney and has been demonstrated to be functional over a temperature range from 0° to 37° C by Ronda (1962).

Figure I-2

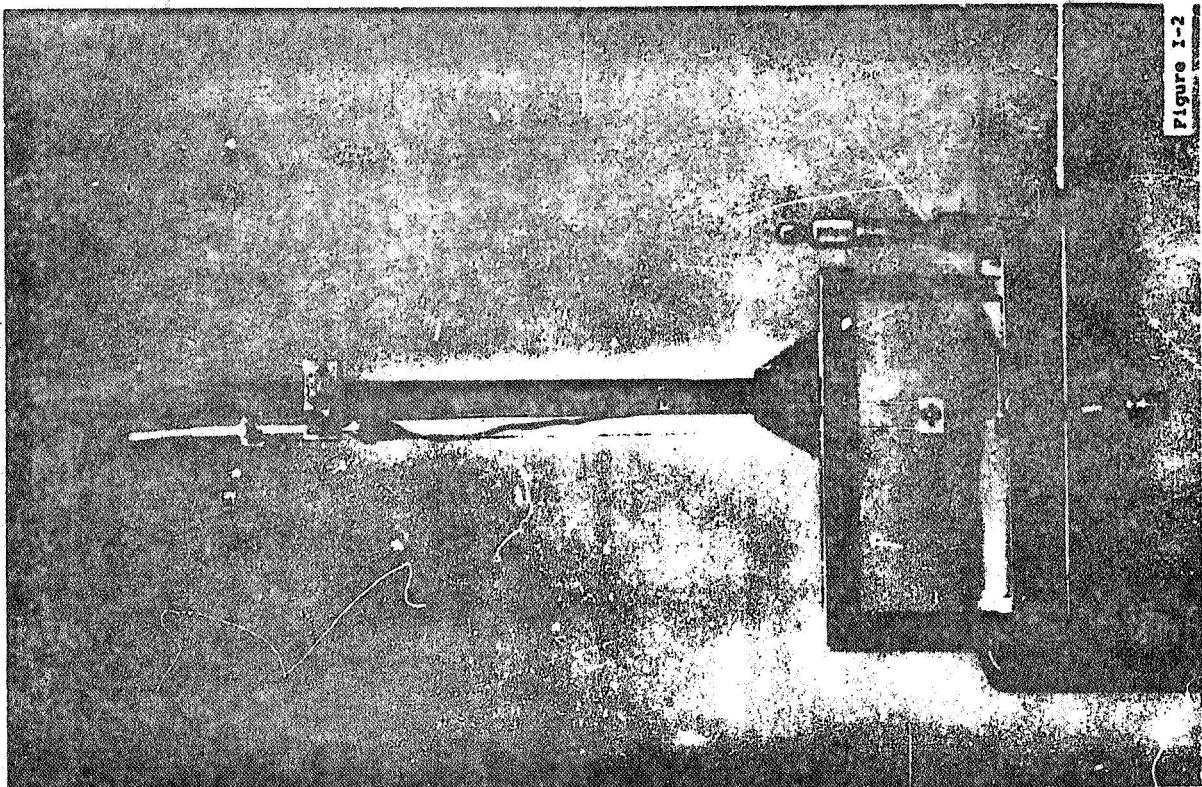
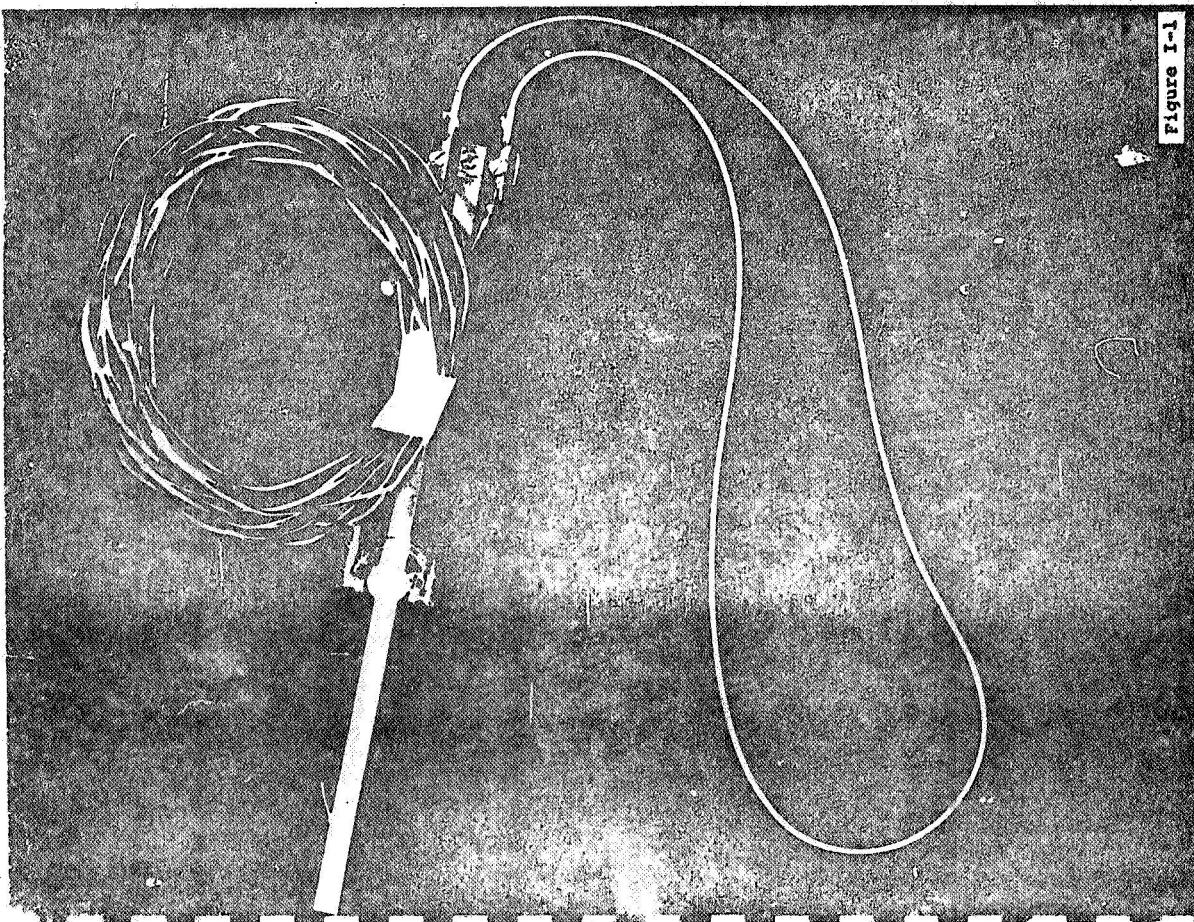


Figure I-1



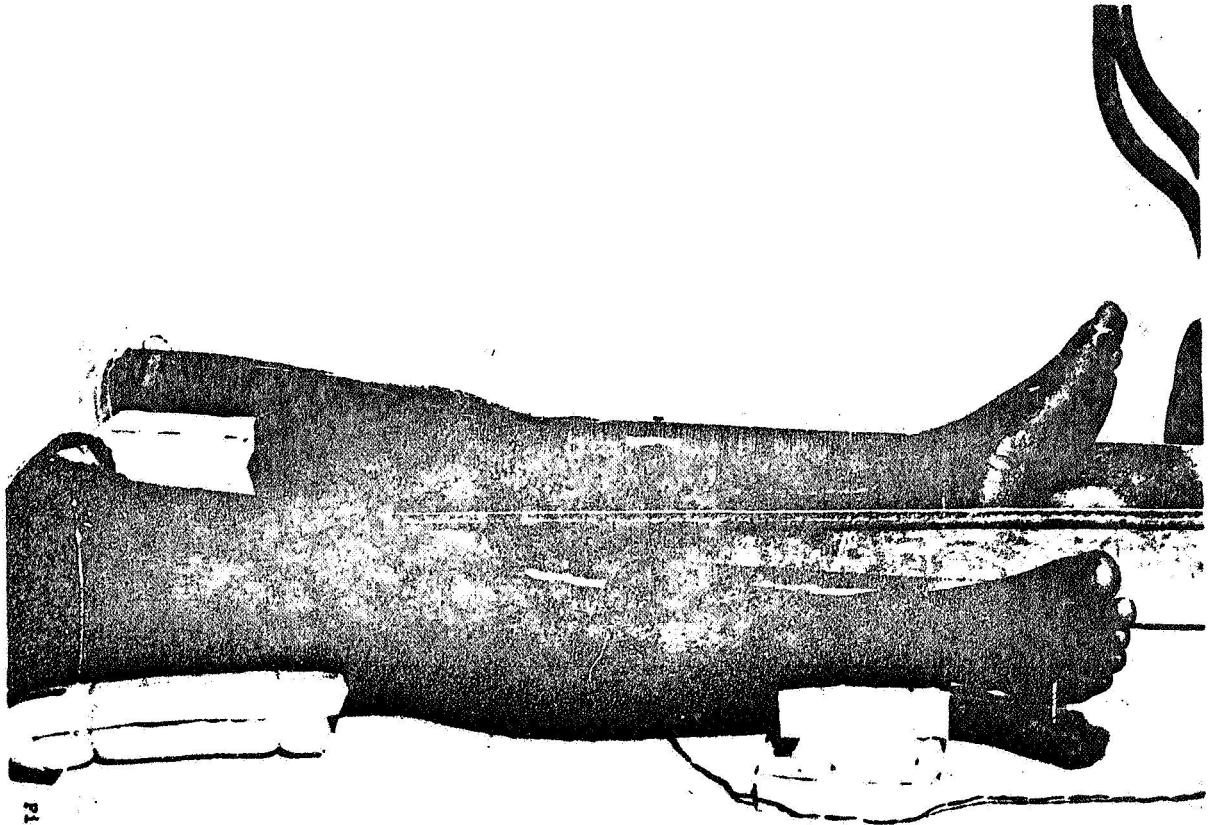


Figure I-3

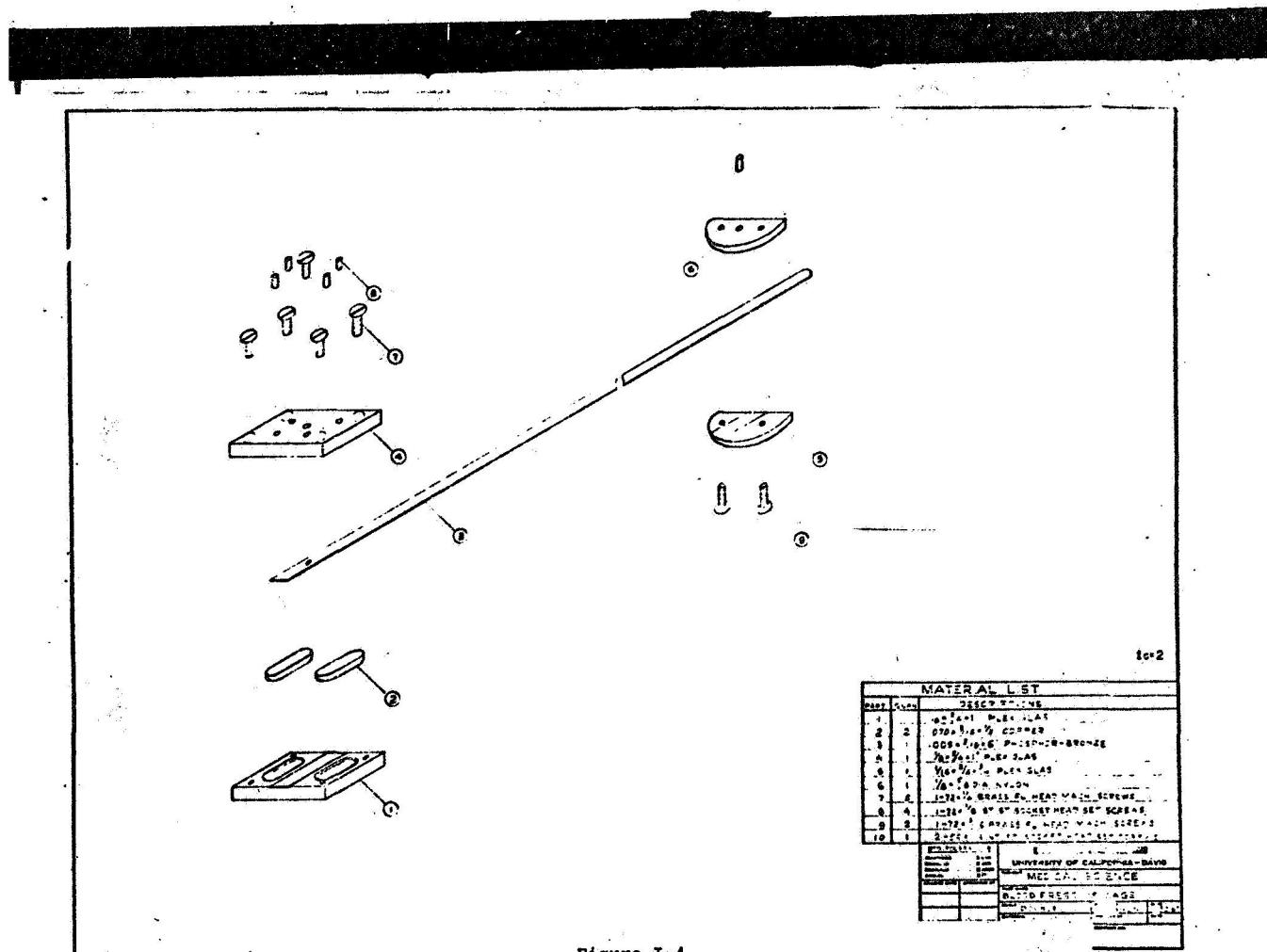


Figure I-4

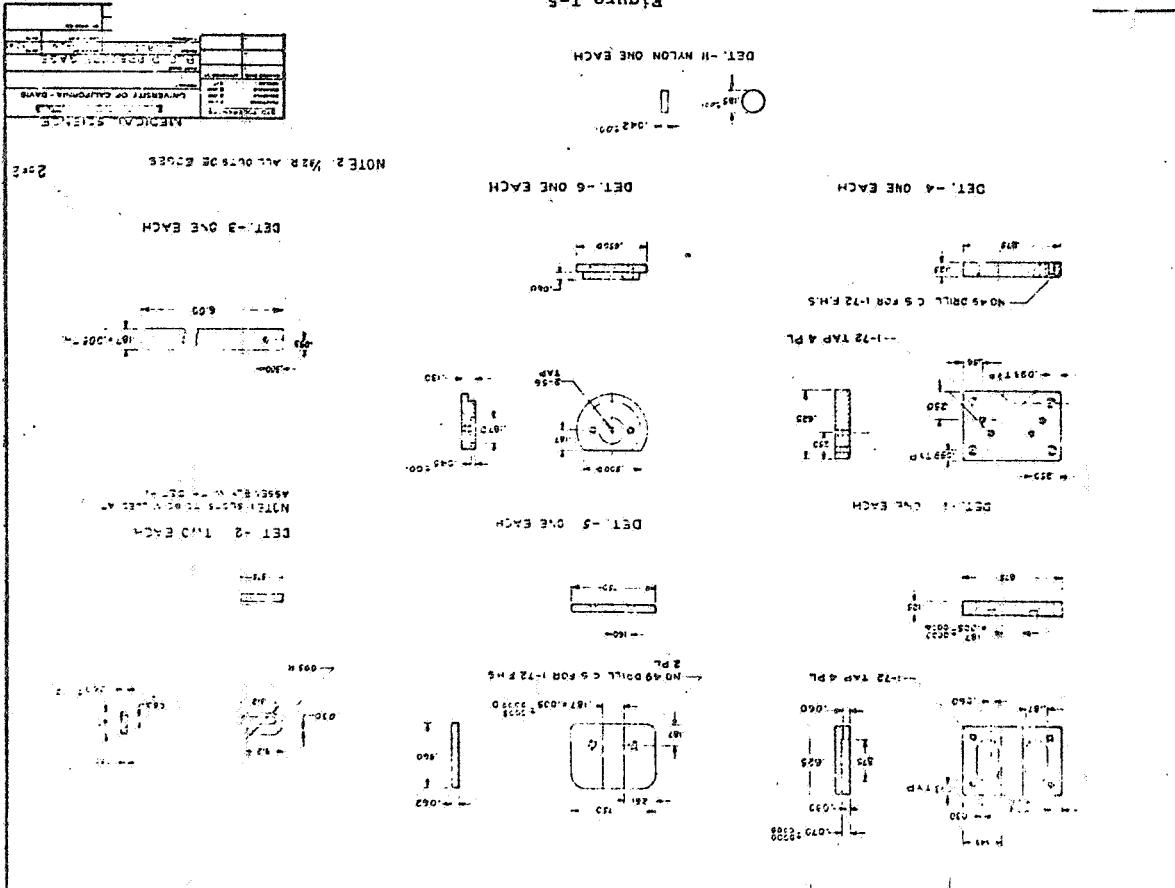
Position and Position artifact

In these experiments, the gauges were carefully positioned around the maximal circumference of the calf of the leg. The standard strain gauge was carefully positioned to cover this circumference. We have tested possible artifacts both in tilt and during negative pressure by positioning gauge proximal and distal to the gauge at the axilla. Circumference in such a position so that the gauges are one centimeter shorter than the maximal circumference gauge. The results of tilt experiments are shown in the accompanying figures to show the correspondence of these gauges and the tilt procedure. A standard tilt (Figure I-6) and a reseal of blood flow with venous occlusion (Figure I-7) show the correspondence. To test for artifact, an arterial occlusion cuff was placed on the thigh and inflated to 200 mm of mercury. The tilt was then repeated. An inspection of these records show that there is some leakage into the limb with the cuff on, seen by a rise in the baseline. The most marked differences are between the upper or proximal gauge and its counterparts more distal during tilt (Figure I-8). With venous occlusion, the gauges also lack correspondence (Figure I-9). There are two possible interpretations of this volume change. One is a slight shift in the "useless" under the garter - the second is the possibility of redistribution of blood in the columns of the veins. Slight changes in the tilt table, as well as maneuvers which cause slight changes in position of the leg, such as pushing on the knee or pulling at the ankle, give similar but much smaller changes in the gauge electrical output (Figure I-10). Experimental maneuvers which cause the knee to be flexed in position during the tilt do not eliminate the artifact shown in the initial figures (Figures I-11 and I-12).

An experiment was devised to determine if this artifact exists with the application of negative pressure to the leg. There is a clear difference in the three gauges - again showing a change during arterial occlusion which might be interpreted as a shift in blood from the upper part of the leg to the lower (Figures I-13, I-14, I-15). Redistribution of blood rather than muscle shift seems a better explanation for the discrepancies based on these experiments.

These tests bring into question the use of the gauge as an index of leg volume change in the tilt table tests. They do not invalidate the data such as were obtained in the bedrest study,

FIGURE I-5



but they seriously constrain the interpretations which may be made. It appears that error is minimal, or at least compensatory, when the plethysmograph is placed at maximal leg circumference.

Capacitance transducer for volume change

Capacitance ratios for plethysmographic measurements have been presented by Hyman, et al (1963) (in preparation of an earlier article proposed by Fitter (1966)) and Fowins and Whalan (1966). The physics of the capacitance system and its application to plethysmography has been described by Fowins and Whalan (unpublished) and is presented here.

The capacitance method for recording volume changes in a limb consists in passing a constant current at a fixed frequency across a capacitor formed by the surface of the limb and the plethysmograph plate which surrounds it. These two plates are separated by a uniform distance. Changes in volume induced by venous occlusion alter the distance between the two plates and thus product changes in electrical capacity which can be detected as voltage changes. Capacity (C), voltage (V) and voltage (C) can be related by the following equation:

$$C = \frac{\pi r^2 A}{d}$$

where A = mean surface area, d = mean distance between arm surface and plethysmograph plate

$$V = \frac{I}{C} \cdot \omega$$

where V = volume of the space between the arm surface and the plethysmograph plate

$$\frac{I}{C} = \frac{I}{j\omega C}$$

where I = current, j is constant and ω = frequency. If I and ω are constant, then

$$\frac{I}{C} = \frac{K_3}{V}$$

In substitution it is found that $V = \frac{1}{j\omega C}$ and $V = r$ for a fixed frequency, constant current system. In such a system, however, two types of errors must be considered

- (1) those due to imperfect correlation between volume and capacity for a constant spacing between the plethysmograph and arm. In practice this type of error can be kept below 1% if the ratio of the plethysmograph plate' circumference to arm circumference is less than 1.4.

(2) Those due to a non-uniform spacing between the plethysmograph and arm which must occur because a small range of plethysmographs is used for all arms and the expansion of the forearm during periods of venous occlusion is not necessarily uniform. This type of error can be kept below 5% by using a spacing of 1.25 ± 0.25 cm between the plethysmograph and the forearm. This spacing also permits a linear relationship between capacity and volume.

The plethysmograph actually measures the volume of the space between the plethysmograph and the surface of the forearm, i.e., the volume between the plates, it is necessary to relate the capacity and volume of this annular space. The capacity between the plethysmograph and arm surface is given by the equation

$$C_T = \frac{\pi r_1 \cdot \pi r_2}{r d} \cdot L \text{ cm units}$$

where C_T = total capacity between plethysmograph and arm
 r_1 = mean arm circumference
 r_2 = mean plethysmograph circumference
 d = mean distance between plethysmograph and arm
 L = effective length of plethysmograph.

The total volume between the plethysmograph and arm (V_T) is given by

$$V_T = \frac{r_1 + r_2}{2} \cdot d \cdot L \text{ ml}$$

Substituting in equation (2) for C obtained from equation (1)

$$V_T = \frac{(r_1 + r_2)}{2} \cdot \sqrt{\frac{r_1 \cdot r_2}{r_1 + r_2} \cdot \frac{L^2 \cdot ml}{C_T}}$$

In practice C_T is measured from a variable capacitor calibrated in microfarads (mf) and $1 \text{ mf} = 0.9 \text{ cm}$.

$$V_T = \sqrt{\frac{P_1 + P_2}{\pi C_T}} \cdot \frac{1/2 (P_1 + P_2)}{3.67 C_T} \cdot L^2 \cdot 1$$

If practice with the specified spacing and ratio between P_1 and P_2 , equation (3) becomes

$$V_T = \frac{A_a^2}{3.67 C_T} \cdot 1$$

where $A_a = 1/2 (\text{area forearm} + \text{area plethysmograph plate})$ sq.cm.

The volume of the arm (V_a) can therefore be calculated from equation (5)

$$V_a = V_p - V_t \cdot ml$$

where V_a = volume of plethysmograph.

The theory of operation is based on the fringing field of the plethysmograph and arm being entirely tuned out with no arm in place and volume and capacity being measured in the space between the plethysmograph and arm with normal planes limiting both the volume and the electrostatic field within the capacitor. In practice this is not possible but by sharing the end screen the same effect is achieved at the expense of the loss of 0.5 cm of plethysmograph length at each end.

The relationship between volume change (ΔV) and capacity change (ΔC) is linear at a spacing of 1.25 ± 0.25 cm and is given by the equation (6)

$$V = \frac{r_a^2}{4 \pi F C_T} \cdot \Delta C$$

where r_a = area of arm surface.

This equation holds true for wide variations in ΔV provided the spacing between the plethysmograph and arm is within the prescribed limits. Equation (6) applies to the situation in which the volume change is distributed equally over the entire forearm. In the unlikely event that all the volume change is located in 20% of the forearm, the error involved is $< 1.0\%$.

Calibration. The most practical way to calibrate the capacitance plethysmograph electrically is to introduce an inductance in series with a capacity equivalent to the capacity between the plethysmograph and arm to give a voltage change of the same order as the changes produced by resting blood flow measurements.

If a substantially constant current of 1 amp be sent through a capacity C_T at a constant frequency ω , then using volt, amp and farad units with ω in radians/sec, the voltage drop across the condenser is given by

$$E = \frac{1}{\omega C_T} \quad \text{volts}$$

$$E = \Delta E = \frac{1}{\omega (C_T + \Delta C)} \quad \text{volts}$$

$$\therefore E = \frac{\Delta C}{\omega C_T^2} \quad \text{volts}$$

Substituting in equation for ΔC obtained from equation 7 and putting 1 farad = 9×10^{-11} cm²

$$V = \frac{\pi A_a^2}{36 \pi 10^{11}} \cdot \frac{\Delta F}{1} \quad ml$$

$$\text{But } \frac{\Delta F}{1} = V \cdot L_C \quad \dots \dots \dots .9$$

where L_C = inductance in Henries
therefore, substituting in equation (8) for $\frac{\Delta F}{1}$ obtained from equation (9)

$$V = \frac{\pi^2 \cdot r_a^2 \cdot L_C}{36 \cdot 10^{11}} \cdot ml$$

The surface area of the arm is the only variable in equation (10) as a value can be chosen for L_C (a circuit constant) so that the volume increment is of any desired value. (In this particular case with a circuit frequency of 6.59 Mc/sec an inductance of 0.27 gives a volume increment of the order of 4.0 ml). The actual calibration of the

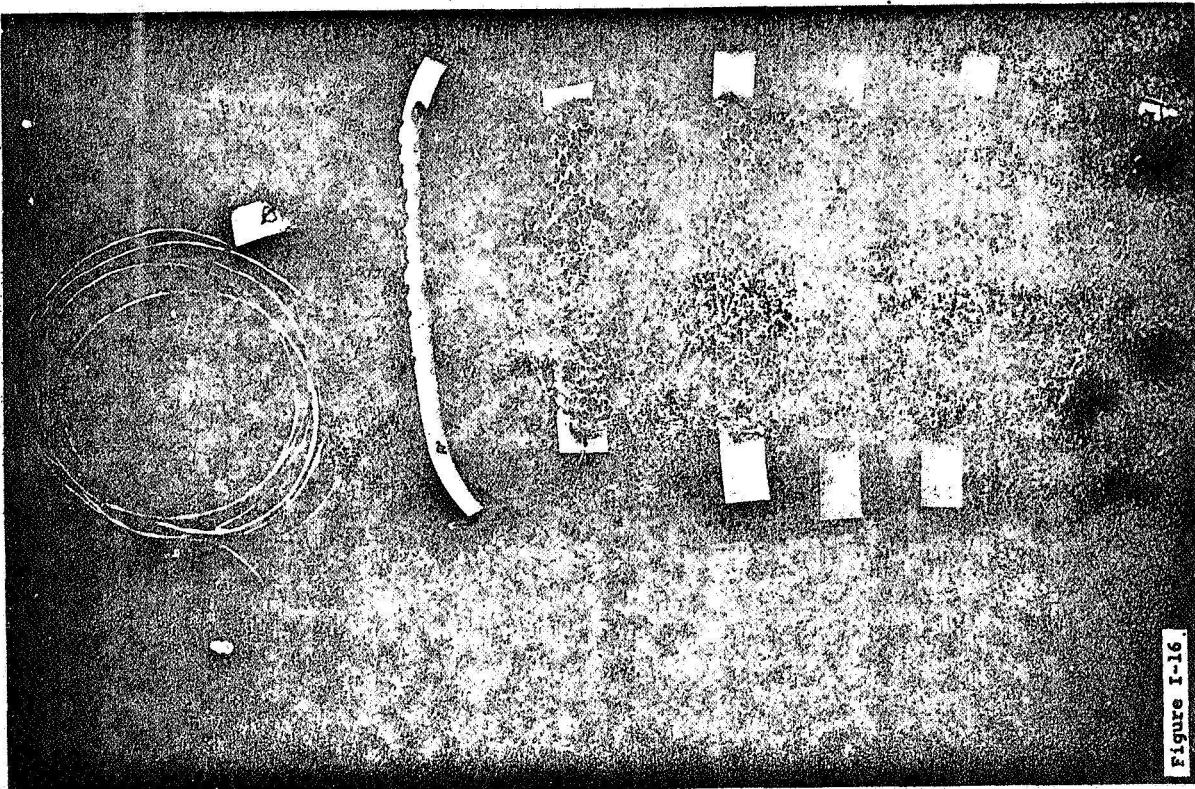


Figure I-16.

Plethysmograph is effected by introducing the calibration inductance in series with a capacity equal to that between the plethysmograph arm. This causes a deflection of the pen recorder equivalent to the known volume increment. From this stem, the displacement caused by a volume increment of 1.0 ml is readily calculated.

Figure I-17 shows the wire net which was used as capacitance device. It is a double-wire netting which was used as capacitance, 7 strands, 31 gauge wire plastic covered on a No. 10-1/2 knitting gauge. The outer dark netting served as a shielding ground and was connected to the arm with a small silver plate. The inner lighter-colored netting served as the capacitor plate which was referenced to the arm. The electrodes were supplied from a Biocom Model 560 capacitance Plethysmograph. This is an 80 kc generator capable of handling 250 tr 1000 sp with an output voltage of 5 "v/nf.

Calibration was accomplished with a flat balloon into which saline is injected.

Figure I-18 is the record from an experiment comparing the capacitance gauge and strain gauge during application of negative pressure to the arm (upper) and during venous occlusion (lower). Record during the tilt procedure is shown in figure I-19, I-20. These records are qualitatively similar. The small quantitative differences are related to the amplitude of the expression of artifacts such as limb movement.

Impedance

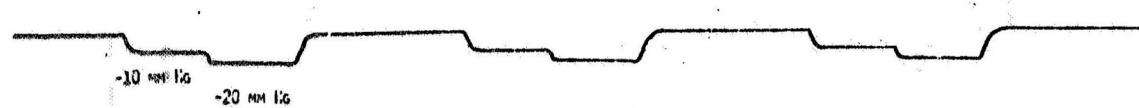
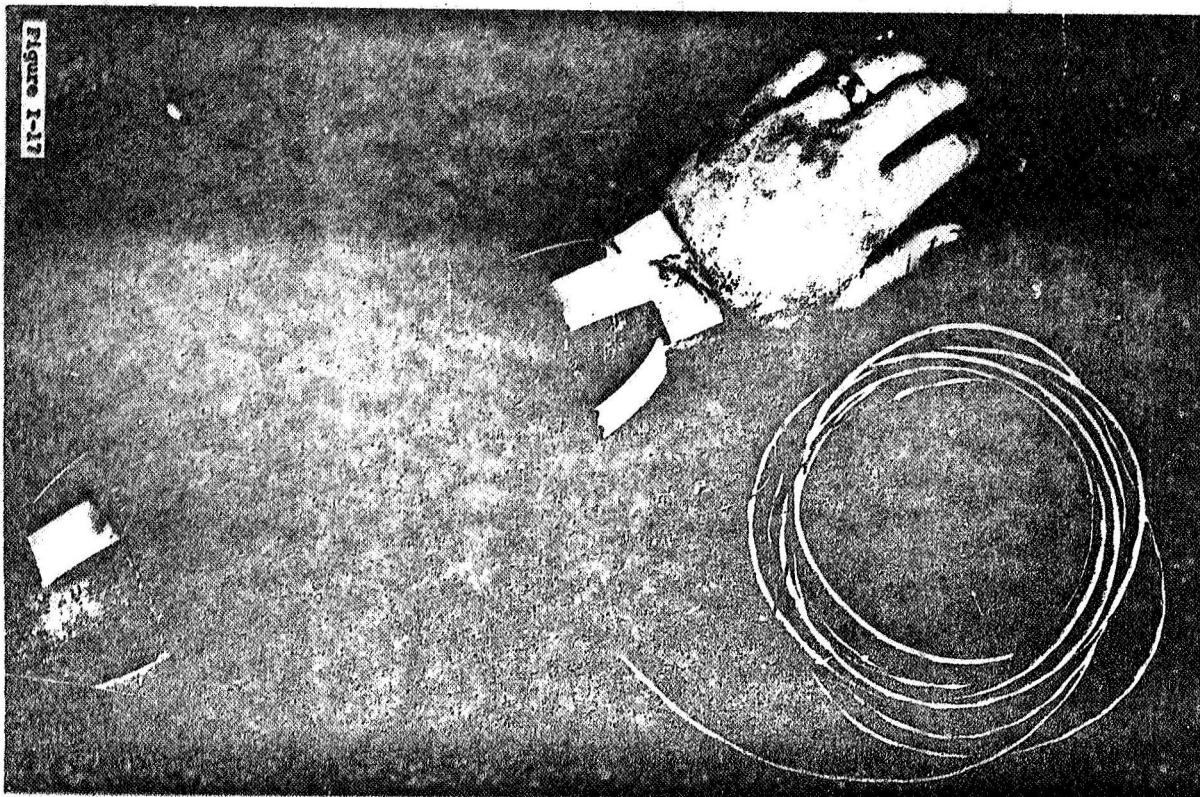
If the length of a cylinder is constant and the volume is changed by a change in cross-section, the change in resistance is proportional to the change in volume.

$$\Delta R = R_1 - R_2 = \frac{1}{V_1} - \frac{1}{V_2}$$

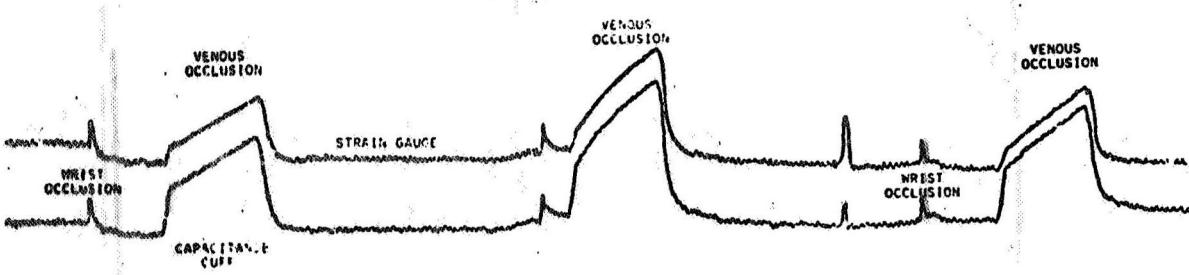
where ρ is specific resistivity.

The fractional change is

$$\frac{\Delta R}{R} = -\frac{\rho V}{V}$$

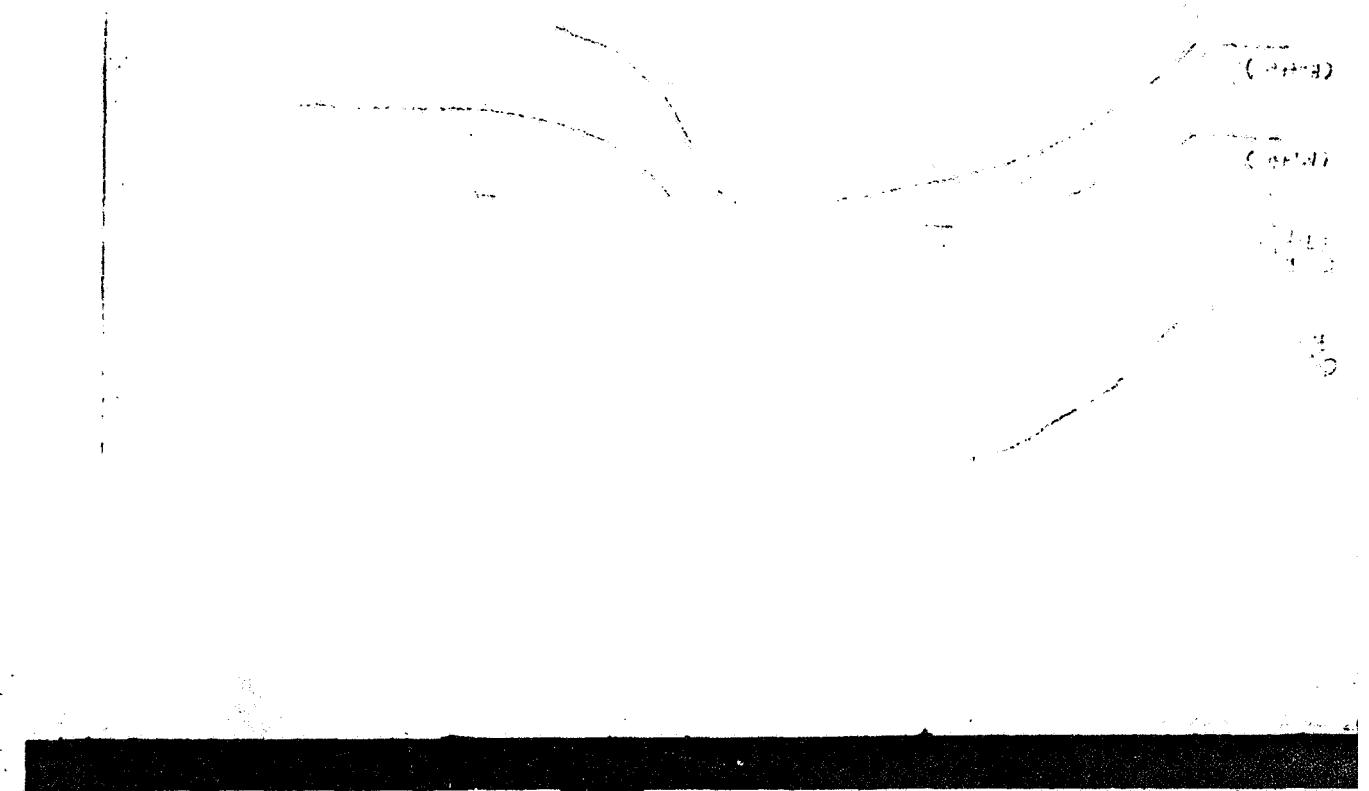


NEGATIVE PRESSURE



VENOUS OCCLUSION

Figure I-18



$$\text{and } \Delta V = -\frac{A^2}{R} \cdot V$$

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Since this ratio depends on the resistance of the tissues, the change in volume (i.e., stirrily in the blood compartment) is in series with a tissue component, and

$$\frac{V_R}{V_B} = V_B \cdot \frac{A^2}{R}$$

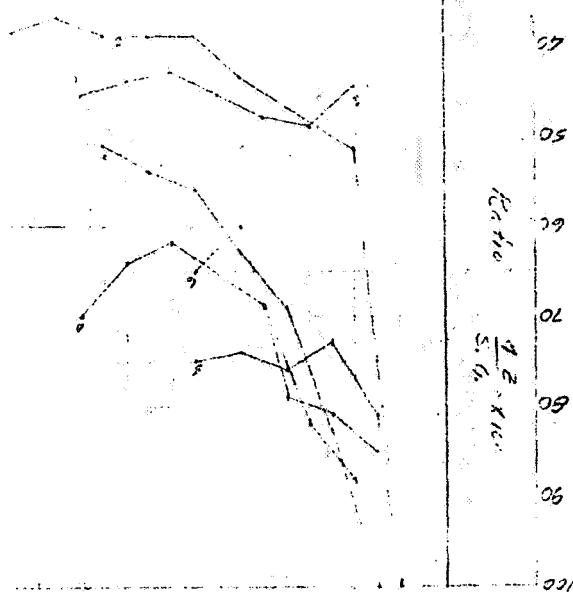
The numerical basis or impedance changes related to volume changes are thoroughly discussed by Vittek (1957).

In these tests "two electrodes were used" - a two-electrode technique similar to the "vibro" technique with the 1 cm electrodes supplied from a Biacore model 30 impedance transducer, 50 KHz activation, and a four-electrode technique described by Allisch (1967) supplied from a Biacore electrical impedance plethysmograph model 102 (50 KHz activation).

Comparison of the impedance technique with the Whitney gauge technique, the ratio of change was used as an indication of conformity. Plots of the ratio of the response of the impedance change to that of the resistance change show the lack of correspondence between the output of the two systems (Figure I-21).

Direct flow measurement.

The application of a transcutaneous Doppler (described by Fischer, et al, 1966) would permit recording of transient changes in volume flow. This method has been used by Sternell (1966).



Technique

Layer on air

Placchimoperab

allertive gauge

Impedance

Capacitance

2-electrode

4-electrode

Basic reference Jullien (1957)

A signal is introduced by variable
electrodes and the size of change
by two other electrodes in each electrode
distance between each electrode is constant.

Basic reference Myhre (1955)

Changes in distance between
electrodes is reflected in the
impedance change due to the
size of electrode.

Basic reference Warren et al (1959)

Ground potential and a screen
shields a charge in volume between
the plates. Impedance is directly related
measures a charge in volume between

Basic reference Hiltney (1955)

charge in length - change in resistance
and length = change in volume.
converted to volume.

Basic reference Hiltney (1955)

charge in length - change in resistance

Basic reference Hiltney (1955)

charge in length - change in resistance

Basic reference Hiltney (1955)

charge in length - change in resistance

Basic reference Hiltney (1955)

charge in length - change in resistance

Basic reference Hiltney (1955)

charge in length - change in resistance

Basic reference Hiltney (1955)

charge in length - change in resistance

Basic reference Hiltney (1955)

charge in length - change in resistance

Basic reference Hiltney (1955)

each of correctional change to slippage area.

each of correctional change to achieve
cyclic motion.

Conclusion

None of the systems tested seem qualified for in flight use.
Each must be used with great care in carefully controlled laboratory
experiments. Interpretation of data obtained from tilt table or
negative pressure must be regarded as tentative due to the possibili-
ties of artifact.

PART II

FIGURE DESCRIPTIONS - PART II

PICTURE

- II-1 Schematic record showing time sequence of tests and measurements (see text).
- II-2 Test set up. Tilt-table in foreground. cable for leg negative pressure test adjacent. Clocks, electronic equipment and stethograph were in view of subject during tilt.
- II-3 Scaled drawing of negative pressure application device.
- II-4 View of the negative pressure application device assembled.
- II-5 Opened negative pressure application device.
- II-6 End view showing inserts to provide for seal at 1^o.
- II-7 Graphic presentation of tilt test. Systolic, diastolic and mean blood pressure in upper traces. Heart rate in lower trace. Set number description in Table II-3.
- II-8 to II-11 Graphic presentation of leg volume change during first three minutes of tilt. Values on ordinate are to be multiplied by 2.5 to obtain per cent change in volume. Set number description in Table II-3.

Introduction

The bedrest study under the direction of Mr. F. Bernauer and supported by NASA contract 05-001-021 included measurements of metabolic balance, basal metabolism, work metabolism, fluid spaces, body composition, strength tests, renal function, bone and urine composition. A total of 10 subjects (Table II-1) were used. Tilt were confined to bed on the calendar schedule shown in Table II-2. Four of the bedrest subjects exercised daily (1 hour at 50% of maximum capacity). The studies reported here were concerned with an evaluation of cardiovascular function following bedrest. Heart rate and blood pressure served as reference and comparative values for other tests.

Procedure

In orientation sessions during the two weeks prior to the study, each subject provided a pertinent medical history, received a full explanation of the procedure and underwent a complete tilt table and negative pressure (NP) run (infra vide).

During the "study", each subject was run before and after bedrest according to the calendar of experimentation (Table II-2). Initially, a.m. and p.m. duplicate runs were conducted at 12-hour intervals until sufficient data were accumulated regarding circadian variation. On the morning of the conclusion of bedrest, the subjects were transferred to the tilt table without rising from horizontal, and the first post-BR was performed. Following 2-1/2 hours of standardized activity, the subjects were run again. The evening of the same day, 12 hours post-BR, a third run was performed. The following morning, 2½ hours post-BR, and the mornings of days 3, 5, 7 post-BR, additional runs were made. In addition to the regular tilt table and NP runs, a measurement of lower leg blood flow by venous occlusion plethysmography was made before and after bedrest as detailed in the calendar of experimentation.

The protocol (Figure II-1) for each run commenced with an equilibration period on the horizontal tilt table for a minimum of 15 minutes. In the first 10 minutes, the necessary instrumentation was accomplished and the subjects were briefly tilted to 70° following

SUBJECT NO. = DOB NUMBER EXERCISE

N_{o.} = BIRTH DATE BY NUMBERS (CALCULATION)

PBO REST

X = THIS TABLE IS FOR NEGATIVE PRESSURE TEST

KEY:

NAME	DATE	EXERCISE	TEST
SW 12			
RS 10			
JW 8			
SL 7			
OS 6			
SL 5			
JV 4			
MG 3			
KC 2			
ER 1			
NAME	6/2/69 01 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100		
SUBJECT NUMBER	301		
AGE			

Table II-1

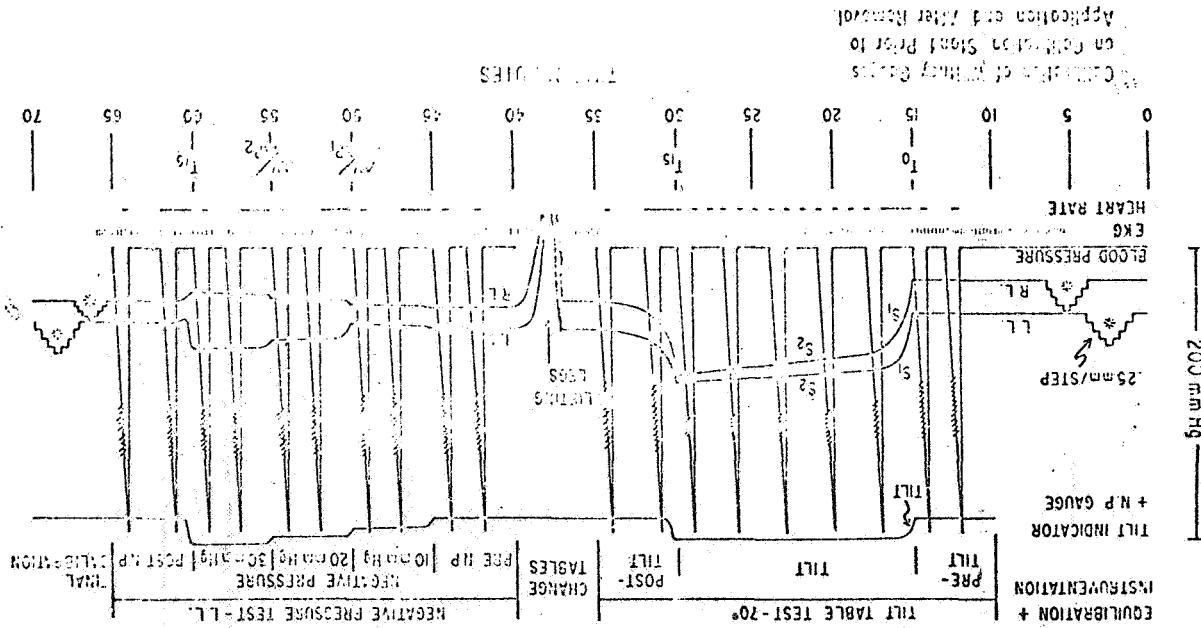
TABLE OF SUBJECTS USED 1967

No.	Name	Weight	Age
1	B. F.	5'9	133 lbs. 19 yrs.
2	X. C.	5'10	150 lbs. 18 yrs.
3	Z. G.	5'6	142 lbs. 20 yrs.
4	J. V.	5'8	155 lbs. 20 yrs.
5	G. J.	5'9-1/2	155 lbs. 19 yrs.
6	D. S.	5'8	137 lbs. 19 yrs.
7	C. L.	6'2	157 lbs. 21 yrs.
8	C. C.	5'10	150 lbs. 18 yrs.
9	D. S.	5'9	164 lbs. 19 yrs.
10	C. W.	5'10-1/2	171 lbs. 19 yrs.

instrumentation to minimize body movement during the subsequent tilt procedure. In the first five minutes of measurement, the EKG and leg circumference measurement ran continuously and the blood pressure was recorded at minute 12 and 1'. At minute 5, tilt to 70° was accomplished gradually over a 15-second period. Tilt was maintained for 15 minutes or until clinical signs of syncope were manifest. Electrocardiogram and leg circumference were recorded continuously. Blood pressure was measured at minutes 17, 20, 23, 26, 29, 31, minute 30, the subject was returned to the supine position over a 15-second period. During minute 30 to 35, EKG and leg circumference were recorded continuously and the blood pressure measured at minute 31 and 3'. At minute 35, the subject was then transferred from the tilt table to a flat table for application of the "Y" device. Measurements of EKG and leg circumference were recorded continuously during transfer. After 5 minutes, during which EKG and leg circumference were measured continuously and two blood pressure measurements were made, 30 mm Hg negative pressure was applied to the left leg in 3 steps of 10 mm Hg for 5 minutes each. Each step of 10 mm Hg was accomplished in about 5 seconds. Data were recorded for 5 minutes following release of EKG and leg volume of both legs were recorded continuously during the negative pressure test and blood pressure at the second and fourth minute of each period. The total run, including instrumentation, averaged about 70 minutes per subject.

The overall experimental setup for use in tests before and after bedrest are shown in figure II-2. The tilt table was obtained from the Vaned Spacecraft Center and modified with the foot supports to hold the legs and feet from movement during tilt. Small potentiometer was mounted on the table in a battery-supplied stone bridge so that the angle of the table could be recorded. The subject was moved from the tilt table to the large table so that negative pressure could be applied to the left leg in the can shown in the figure. A shop vacuum cleaner provided the suction for the can panels contained the instrumentation to activate and record the gauges as well as record blood pressure and heart rate. Cuffs for blood pressure were inflated from preset tank pressure. The whitene gauges were activated from a Parks Model 270 bridge and the output of

FIGURE II-1



LEG VOLUME MEASUREMENT

The bridge fed through the CEC model 1-155 amplifiers into the optical recorder. The EEC was fed through the CEC amplifiers to the recorder. Blood pressure was recorded with an ECG Electrostethograph "Mark IV". The strain gauge recorded the pressure in the negative pressure tank.

The negative pressure can, or "clay-can" as it came to be known, was built specifically for those tests, and was used in preference to lower body negative pressure, since the object of the measurement was change in volume of the leg and problems involved with respect to shifts of blood distribution and, when the lower body is involved, include more than muscle and skin in the leg. The can is shown in perspective in Figure II-3 and in three views of the device in Figures II-4, II-5, II-6. As shown in the final figure of the can, inserts were made approximately to fit the leg to prevent the scaling number error from being sucked into the can.

L'ESPRESSO

All data was recorded on a CEC Macerating Counter using a paper spot of 1/minute.

A standard tilt table with a pneumatic saddle was used (Figure II-2). The slope of the tilt and recline was recorded using a battery powered 5 K potentiometer inserted at the axis pin and plugged directly to a light galvanometer on the oscillosograph. An event marker was wired into this system.

p.
55.

A commercial vacuum cleaner supplied by a garage in a clear-can (Figure II-2) sealed around the upper left thigh of the subject. Can pressure was monitored by a mercury manometer inserted in a T-line with a Stetham differential pressure transducer whose signal was amplified by a C Carrier NIP 1-118 and recorded on the oscilloscope.

Heart Rate

Heart rates were calculated from continuous EKG recordings, detected by chest leads and using CEC DC NMP Type 1-155.

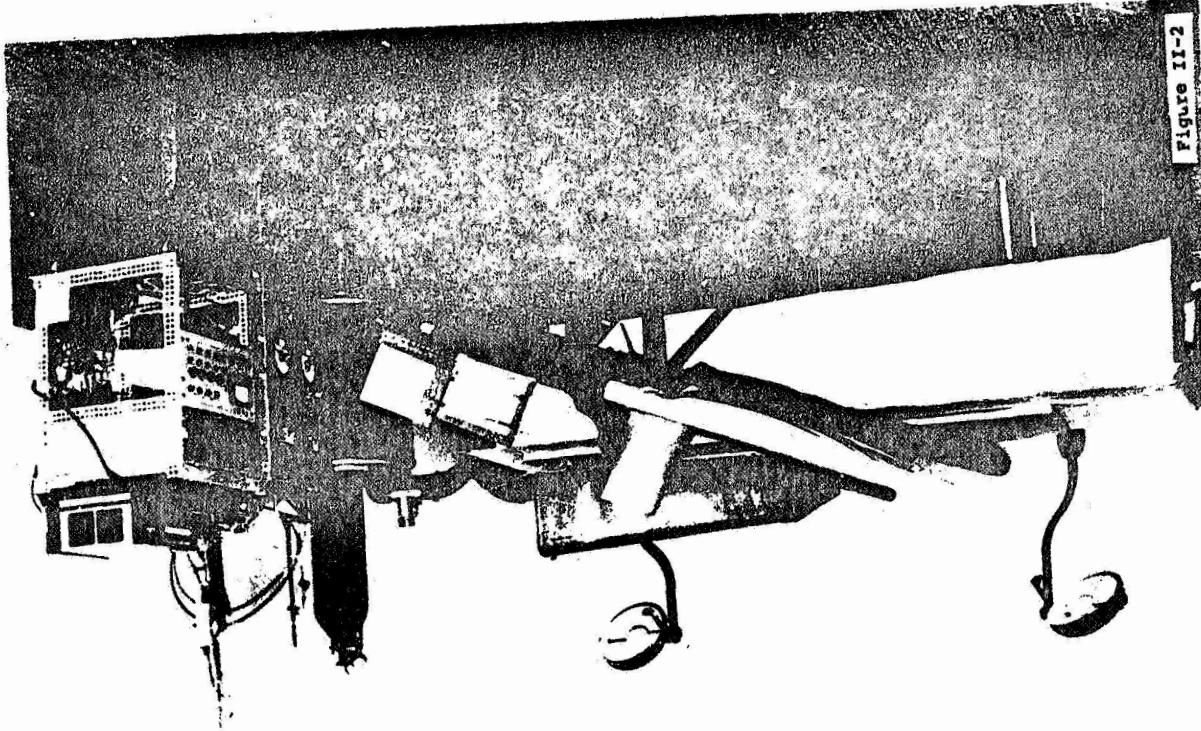


Figure II-2

NEGATIVE PRESSURE CAN
"CLAM TYPE"

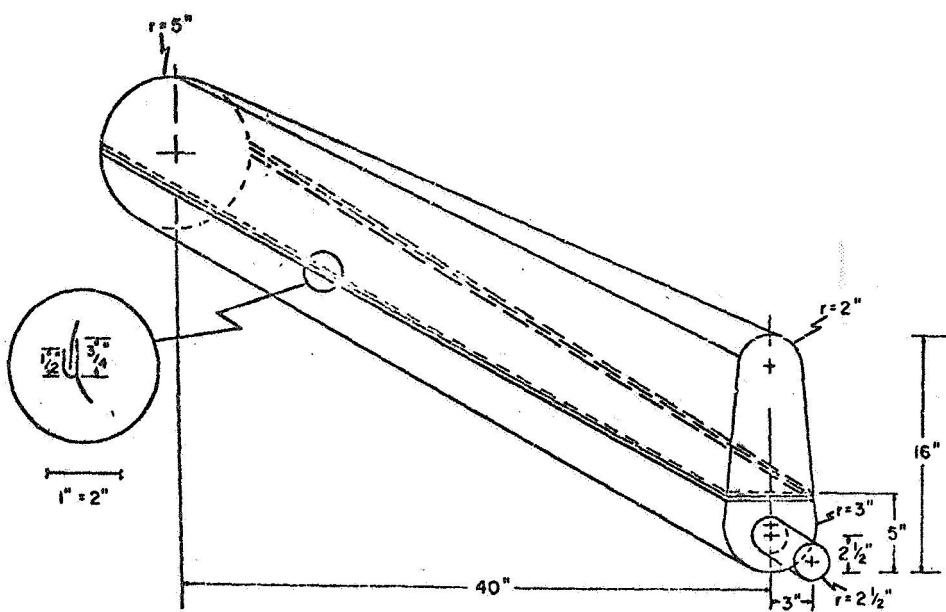


Figure II-3

Scale: $1" = 5"$

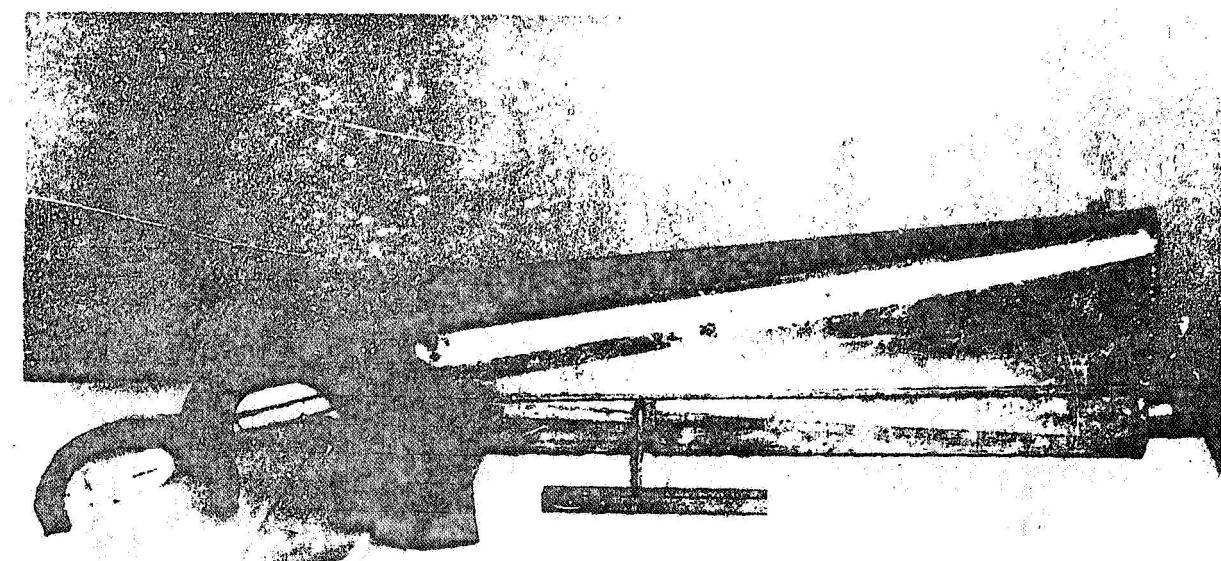


Figure II-4

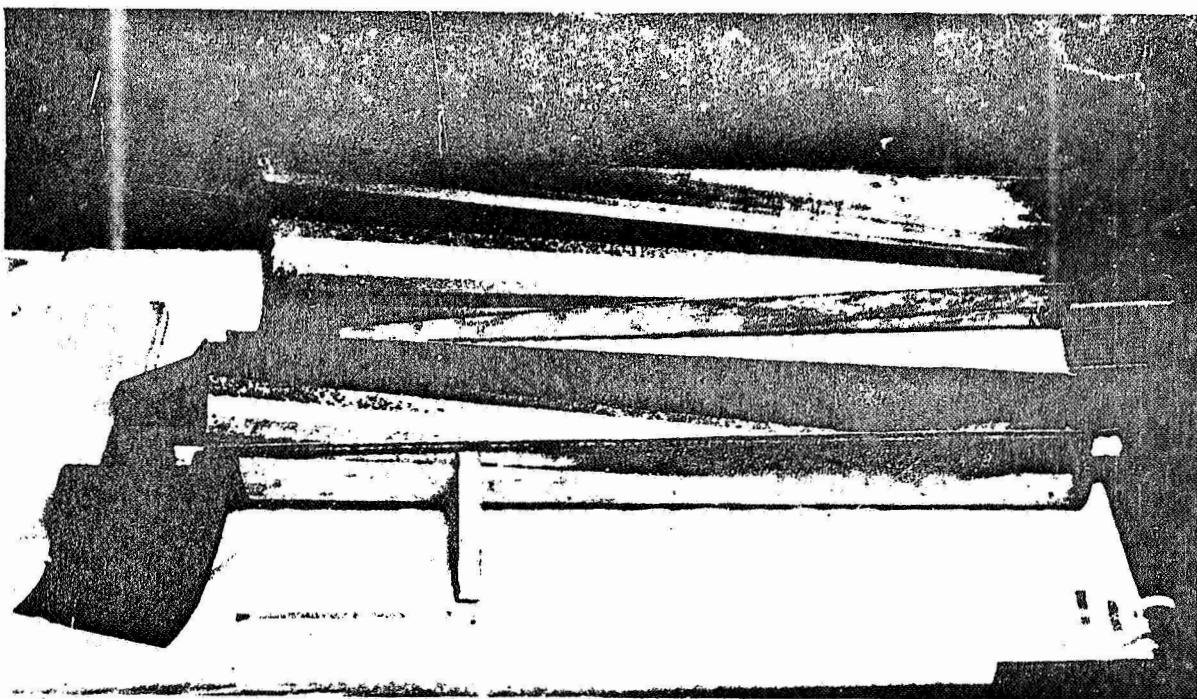


Figure II-5

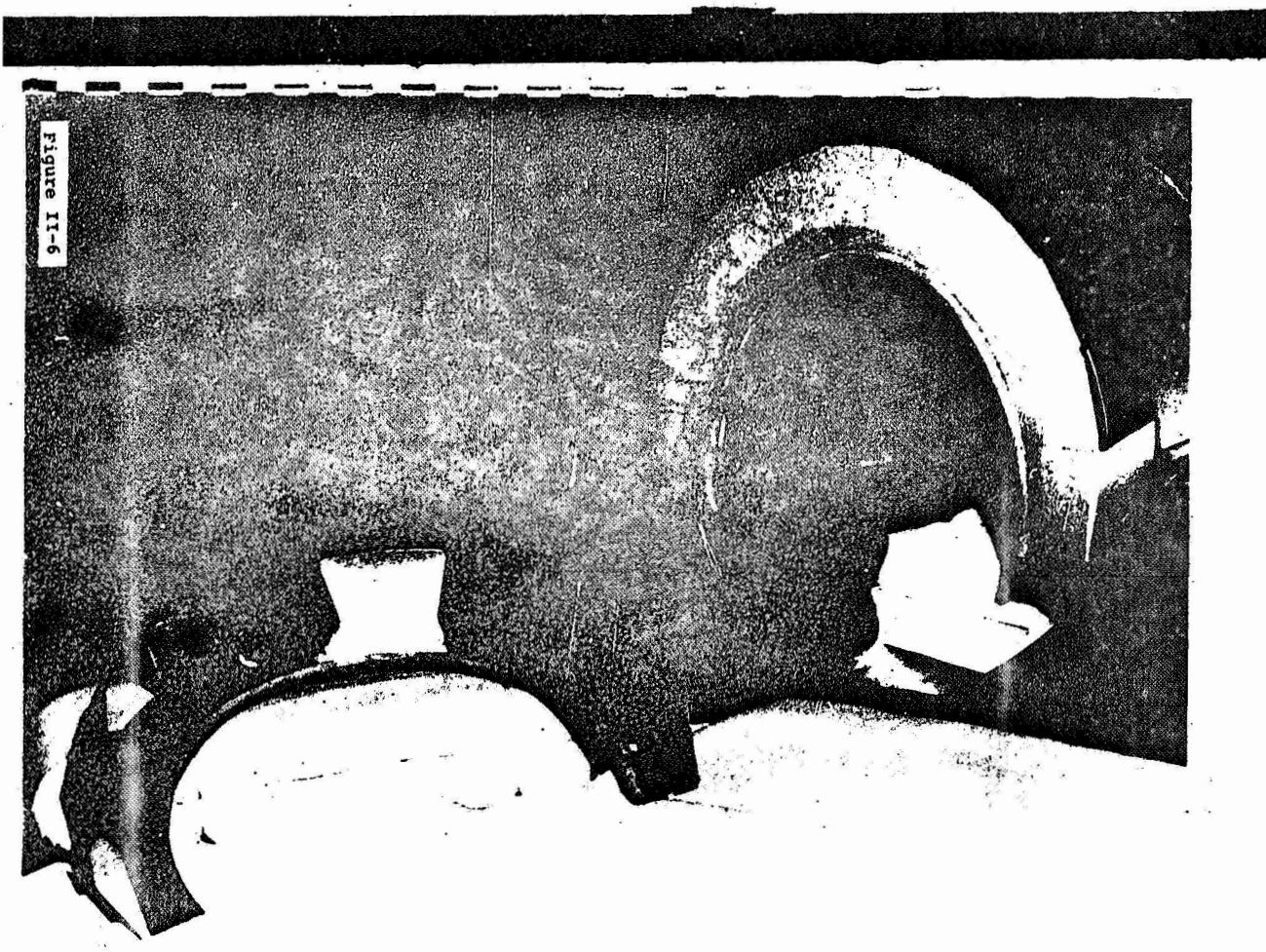


Figure II-6

Table II-3 Description of Beta assembly system

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वर्णसंकेत

Blood pressure was recorded at 2-3 minute intervals using a manometer, inflation microphone equipped 15 cm occlusal cuff or the 100 mm Hg electrosphygmograph. The signal was amplified by an electronic physiograph VII and pressure tracings recorded on the millimeterograph. The peak pressure was held at 200 mm Hg on the millimeterograph for 1 second and then released to decrease through a crifice over a 30-second period. The first distinct sound was taken as systolic pressure and the last distinct sound taken as diastolic.

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A bimetallic strain gauge was applied to the measured maximum circumference of each calf following stand calibration. Gauge tension was zero during pre and post run calibrations and this was closely approximated on application of the gauge to the leg. Parts total 22 mm in length. D.C. outlet signal was amplified by CRC 1-155 "C" type and recorded on the oscilloscope. The change in volume was calculated from the circumference change with the approximations noted in Part

Table I. *Sugars*

The data have been ascribed in sets which represent the individual and group treatments in time in Table VI-3.

Year Data and Present Trends

While those cited serve primarily as a reference for comparison with other studies, a number of mean values and derivatives are

The time course changes in systolic and diastolic blood pressure and in heart rate are given in Figures II-7 to II-35

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The first volume change was analyzed with respect to several features of the time course of change. The initial slope is termed

A complete set of data on computer stationery is appended to the first copy of this report.

Table II-4

Condition	Time in Min.										Condition	Time in Min.						
	0	.075	.175	.25	1.00	2.00	2.96	0	.075	.175		0	.075	.175	.25	1.00	2.00	2.96
Set 1	-0.000	0.151	0.563	0.262	1.661	2.255	2.562				Set 17	-0.000	0.234	0.834	1.123	1.946	2.363	2.166
	-0.000	0.0982	0.1564	0.1906	0.1945	0.2168	0.5591				Set 18	-0.000	0.253	0.738	1.043	1.820	2.176	1.698
Set 2	-0.000	0.291	0.673	0.936	1.868	2.271	2.499				Set 19	-0.000	0.0668	0.1597	0.1995	0.3131	0.3288	0.8268
	-0.000	0.0523	0.2426	0.3302	0.2689	0.1988	0.2090				Set 20	-0.000	0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
Set 3	-0.000	0.105	0.049	0.098	0.932	1.442	1.935				Set 21	-0.000	0.173	0.421	0.573	0.938	1.329	1.690
	-0.000	0.1255	0.5484	0.5584	0.7742	0.9452	1.0716				Set 22	-0.000	0.205	0.681	0.905	1.588	2.031	2.013
Set 4	-0.000	0.059	0.001	0.286	0.857	1.364	1.942				Set 23	-0.000	0.272	0.733	1.014	1.810	2.097	1.523
	-0.000	0.0669	0.2670	0.3411	0.4813	0.5061	0.4952				Set 24	-0.000	0.1135	0.1840	0.3156	0.4927	0.5817	1.2243
Set 5	-0.000	0.162	0.555	0.789	1.594	2.079	2.554				Set 25	-0.000	0.214	0.773	1.147	1.908	2.131	0.437
	-0.000	0.0446	0.2969	0.3701	0.3842	0.2630	0.8183				Set 26	-0.000	0.0424	0.0546	0.0620	0.2691	0.2791	1.2442
Set 6	-0.000	0.234	0.549	0.6661	1.192	1.735	1.885				Set 27	-0.000	0.325	0.759	1.242	1.381	1.625	0.686
	-0.000	0.0553	0.2319	0.3603	0.3578	0.4233	0.6851				Set 28	-0.000	0.1033	0.2292	0.2518	0.2960	0.3040	0.8253
Set 7	-0.000	0.249	0.593	0.933	1.784	2.295	2.540				Set 29	-0.000	0.318	0.829	1.144	2.033	2.408	2.434
	-0.000	0.0960	0.1771	0.2174	0.1980	0.2373	0.3157				Set 30	-0.000	0.0349	0.1456	0.1947	0.2249	0.1956	0.3721
Set 8	-0.000	0.235	0.628	0.922	1.596	2.074	2.047				Set 31	-0.000	0.179	0.6112	0.9111	1.748	2.239	2.410
	-0.000	0.0989	0.3398	0.3162	0.2720	0.2560	0.7027				Set 32	-0.000	0.0529	0.0922	0.1060	0.1520	0.1611	0.2440
Set 9	-0.000	0.310	0.650	1.041	1.731	1.888	2.098				Set 33	-0.000	0.318	0.829	1.144	2.033	2.408	2.434
	-0.000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000				Set 34	-0.000	0.165	0.334	0.609	1.261	1.773	2.012
Set 10	-0.000	0.235	0.600	1.121	2.010	2.493	2.135				Set 35	-0.000	0.128	0.183	0.450	1.343	1.818	1.803
	-0.000	0.1599	0.5663	0.6454	0.8849	0.8272	1.5547				Set 36	-0.000	0.0738	0.2466	0.2939	0.4424	0.4685	0.7405
Set 11	-0.000	0.204	0.657	0.957	1.829	2.224	2.268				Set 37	-0.000	0.165	0.334	0.609	1.261	1.773	2.012
	-0.000	0.0551	0.1153	0.1205	0.2458	0.2592	0.4242				Set 38	-0.000	0.0830	0.1956	0.2174	0.2812	0.2973	0.4327
Set 12	-0.000	0.347	1.001	1.372	2.215	2.559	2.362				Set 39	-0.000	0.195	0.609	0.845	1.773	2.233	2.296
	-0.000	0.0489	0.1323	0.1871	0.3914	0.3696	0.8206				Set 40	-0.000	0.0511	0.1690	0.2002	0.2538	0.2657	0.5559
Set 13	-0.000	0.147	0.377	0.744	1.685	2.132	1.776				Set 41	-0.000	0.208	0.543	0.708	1.287	1.827	1.651
	-0.000	0.1210	0.1731	0.2313	0.5664	0.5316	1.3403				Set 42	-0.000	0.0699	0.1423	0.2081	0.2299	0.2671	0.5840
Set 14	-0.000	0.245	0.584	0.850	1.564	2.079	2.064				Set 43	-0.000	0.241	0.768	1.062	1.870	2.331	2.340
	-0.000	0.1285	0.1845	0.2261	0.2732	0.3086	0.7620				Set 44	-0.000	0.0581	0.1595	0.2215	0.2117	0.1932	0.4252
Set 15	-0.000	0.0225	0.1631	0.201	1.951	2.387	2.637				Set 45	-0.000	0.244	0.683	0.982	1.708	2.125	1.972
	-0.000	0.1006	0.2303	0.2493	0.3807	0.5127	0.5102				Set 46	-0.000	0.0533	0.1688	0.1913	0.1868	0.4891	0.4891
Set 16	-0.000	0.174	0.534	0.770	1.415	1.950	1.339				Set 47	-0.000	0.242	0.536	0.807	1.4779	2.5004	1.7654
	-0.000	0.1739	0.2145	0.2488	0.3535	0.3987	1.2450				Set 48	-0.000	0.219	0.737	1.029	1.785	2.246	1.894
Set 17	-0.000	0.0701	0.2373	0.2761	0.3918	0.3697	0.7041				Set 49	-0.000	0.219	0.737	1.029	1.785	2.246	2.070

Fig. 1 and is assumed to describe the various filling. The second slope (S2) is assumed to be related to capillary filtration. The final point in time of Time 2 is designated T15 and is the maximum filling. Extrapolation of S2 to T10 gives a value of available initial filling capacity. The values appear in Table II-4.

Percent heart rate volume changes with tilt at 3 and 2.5 hours post-exercise are dramatically from pre-test values that those curves were significantly ($p < .05$) lower at 3, 5 and 7 days post-exercise than pre-exercise. At 3, 5 and 7 days post-exercise the filling curves were significantly lower at 3 minutes after tilt, but were significantly higher at 5, 10 and 30 seconds after tilt. The four students who were exercised during breakfast showed greater change in the filling curve than the four who did not exercise. The values at seven time intervals are assembled in Table II-5 with their standard deviations.

Physical data are assembled in Table II-6 to give the material for calculation of an integrated score according to the system suggested by Venjari, et al. (unpublished).

Low Negative Pressure Test

Heart rate and blood pressure. Application of negative pressure to the left leg at increments of 10 mm Hg up to 30 mm Hg caused the heart rate to increase (Table II-4).

The change in volume with change in pressure (dv/dP) or compliance was altered following heart rate increase a decrease in compliance.

Table VI-5
TILT TABLE TESTS Values and standard deviation

Measure	Condition	SET 1	SET 2	SET 3	SET 4	SET 5	SET 6	SET 7	SET 8	SET 9	SET 10
	Heart Rate	Condition									
	Heart Rate	Heart Rate									
Avg Pre-Tilt	60.250	66.667	53.000	54.500	71.000	59.000	58.500	56.500	-8.000	52.500	3.42
	2.75	15.93	3.46	9.57	9.59	7.75	8.85	3.42	0.00		
Avg During Tilt	86.770	99.619	83.708	87.117	99.221	91.151	81.936	81.231	73.300	75.013	5.56
	9.28	13.77	9.35	11.31	8.20	13.09	9.66	11.05	0.00		
Max During Tilt	95.500	96.000	103.000	101.000	109.000	105.000	92.000	93.000	80.000	81.000	
	11.80	11.15	11.19	15.45	8.25	15.45	11.78	13.61	0.00	6.83	
Delta Hr Avg	26.520	22.952	30.708	32.617	28.221	32.151	23.436	27.731	25.800	22.513	
	9.04	8.03	10.05	11.18	5.33	10.51	4.14	9.51	0.00	4.35	
Delta Hr Max	35.250	29.333	50.000	46.500	38.000	33.500	36.500	32.000	28.500		
	10.79	7.45	13.56	13.30	7.83	10.71	6.40	11.59	0.00	4.12	
Pct Delta Hr Max	158.363	146.861	195.569	189.308	154.993	178.331	158.105	164.344	166.667	154.202	
	17.00	17.31	31.19	35.90	16.81	16.47	13.48	18.41	0.00	6.12	
Delta Hr Return	-6.000	-7.333	-5.500	-4.500	-9.500	-0.000	-6.000	-3.500	-26.000	-1.000	
	4.00	4.32	6.19	1.91	6.19	8.00	4.32	6.19	0.00	2.31	
Pct Delta Hr Return	90.089	88.626	89.104	91.435	85.658	99.789	86.090	93.399	15.833	92.309	
	6.54	6.51	12.97	11.50	11.51	13.31	9.37	11.81	0.00	4.58	

TILT TABLE TESTSTILT TABLE TESTS

Measure	Condition	SET 11	SET 12	SET 13	SET 14	SET 15	Condition	SET 16	SET 17	SET 18	SET 19	SET 20
Heart Rate							Heart Rate					
Avg Pre-Tilt	62.590 8.65	69.167 7.11	64.000 6.93	63.000 7.75	84.000 8.33		Avg Pre-Tilt	70.000 11.14	74.500 13.00	68.000 8.49	76.000 0.00	65.500 9.00
Avg During Tilt	87.213 6.25	90.140 5.17	100.372 13.17	103.000 19.42	110.305 8.06		Avg During Tilt	98.816 20.23	98.624 18.22	89.714 4.13	105.333 0.00	86.800 11.13
Max During Tilt	98.500 6.39	97.333 5.47	117.000 16.45	118.000 21.79	122.000 7.66		Max During Tilt	109.333 22.03	108.000 19.32	99.000 5.03	120.000 0.00	94.000 9.52
Delta Hr Avg	24.713 9.05	20.973 5.09	36.372 8.71	40.000 12.35	26.305 2.31		Delta Hr Avg	28.816 9.11	24.124 5.44	21.714 6.95	29.333 0.00	21.300 11.16
Delta Hr Max	36.000 9.26	28.167 5.00	53.000 12.81	55.000 15.53	38.000 7.30		Delta Hr Max	39.333 11.37	33.500 7.19	31.000 9.31	43.000 0.00	28.500 10.25
Pct Delta Hr Max	159.621 21.13	141.481 10.79	182.929 17.93	186.499 18.65	145.939 12.31		Pct Delta Hr Max	155.575 8.21	144.919 5.43	147.204 19.27	157.895 0.00	144.797 18.64
Delta Hr Return	-3.750 4.95	-4.833 5.60	-3.000 4.16	-1.000 2.00	-4.500 3.00		Delta Hr Return	-4.667 3.06	-7.000 9.45	-2.000 8.64	2.000 0.00	-3.000 5.51
Pct Delta Hr Return	94.287 7.85	92.813 8.72	95.709 6.55	98.485 3.03	94.786 3.16		Pct Delta Hr Return	93.164 4.31	92.129 13.26	97.804 12.59	102.622 0.00	94.966 7.73

TILT TABLE TESTSTILT TABLE TESTS

Measure	Condition	SET 21	SET 22	SET 23	SET 24	SET 25	SET 26	SET 27	SET 28	SET 29	SET 30
Heart Rate	Condition										
Avg Pre-Tilt	65.500	69.000	66.000	61.305	67.917	58.500	56.750	77.000	63.74	66.500	
	11.70	16.85	2.31	5.83	11.87	7.76	9.25	10.84	10.29	13.38	
Avg During Tilt	80.989	80.948	93.910	86.392	89.879	92.040	95.059	101.763	54.436	90.280	
	22.40	24.00	7.84	7.99	9.92	13.82	17.59	9.58	15.46	16.18	
Max During Tilt	88.000	87.000	91.000	97.000	96.667	110.000	109.500	115.500	106.857	100.000	
	25.51	27.01	11.02	9.30	9.62	15.12	19.70	10.13	16.93	17.10	
Delta Hr Avg	15.489	11.948	17.910	25.617	21.963	Delta Hr Avg	33.540	36.309	27.263	30.721	23.780
	12.71	7.61	8.89	8.79	6.49		9.22	11.60	3.94	9.28	4.43
Delta Hr Max	22.500	18.000	25.000	35.625	28.750	Delta Hr Max	51.500	50.750	38.000	43.113	33.500
	16.11	10.71	11.94	9.72	6.08		12.32	14.17	7.01	10.64	6.30
Pct Delta Hr Max	132.894	124.643	138.143	158.992	144.171	Pct Delta Hr Max	189.249	187.403	150.466	168.578	151.512
	21.28	10.55	18.89	16.54	14.04		24.50	26.50	14.47	17.50	11.84
Delta Hr Return	-5.500	-4.500	-4.500	-4.875	-6.083	Delta Hr Return	-4.250	-2.750	-7.000	-2.000	-6.500
	3.42	3.42	2.52	4.50	4.92		5.06	2.60	5.24	6..3	6.82
Pct Delta Hr Return	91.874	93.808	93.244	92.188	90.719	Pct Delta Hr Return	92.407	94.960	90.222	96.950	90.609
	4.65	4.38	3.62	7.31	7.66		10.14	5.18	9.21	10.49	10.64

TILT TABLE TESTSTILT TABLE TESTS

Measure	Condition	SET 1	SET 2	SET 3	SET 4	SET 5
<u>Heart Rate</u>						
Avg Pre-Tilt	62.250 8.58	62.000 19.80	59.000 9.36	109.333 9.65	110.563 10.54	117.500 3.94
Avg During Tilt	86.973 9.26	89.567 22.30	80.907 10.30	55.063 11.69	46.093 2.29	68.750 7.70
Max During Tilt	96.000 10.03	100.000 28.28	87.500 10.35	55.500 10.14	63.250 9.36	53.250 5.56
Delta Hr Avg	24.723 8.36	27.567 2.50	21.907 7.87	73.562 9.96	67.167 4.66	83.625 9.40
Delta Hr Max	33.750 10.17	38.000 6.49	28.500 7.23	116.325 7.56	117.467 10.51	122.050 12.13
Pct Delta Hr Max	155.774 19.71	162.281 6.20	149.500 13.79	111.125 9.66	111.667 8.33	116.000 10.68
Delta Hr Return	-2.750 7.01	-12.000 19.00	-3.750 3.92	71.525 7.44	71.267 4.00	82.567 6.00
Pct Delta Hr Return	95.602 11.55	74.232 40.16	93.638 6.05	77.125 6.49	76.333 3.56	88.250 6.13
Avg Tilt Pulse				45.300 8.28	46.200 13.63	39.483 6.20
Min Tilt Pulse				37.375 10.60	36.167 11.09	29.000 6.68
Max Tilt Pulse				86.625 6.38	86.667 2.50	88.250 8.03
Avg Tilt Mean				92.792 7.24	94.056 2.82	91.750 7.39
Avg Sys Post-Tilt				113.875 11.13	111.250 6.86	122.750 15.18
Avg Dia Post-Tilt				52.375 11.42	46.250 3.71	63.750 8.63
Delta Dia Avg				16.462 8.55	25.183 5.33	16.692 1.76
Delta Dia Max				22.063 10.26	30.250 4.98	22.375 3.71

TILT TABLE TESTS

Measure	Condition	SET 6	SET 7	SET 8	SET 9	SET 10
<u>Blood Pressure</u>						
Delta Pulse Avg	11.975 14.50	13.075 16.96	10.313 3.34	-3.800 0.00	15.675 9.61	
Delta Pulse Max	22.125 14.14	23.125 18.67	24.875 14.77	8.000 0.00	28.125 15.91	
Pct Delta Pulse	60.948 23.79	63.959 25.10	52.262 14.91	78.947 0.00	46.434 31.46	
Delta Mean Avg	11.458 3.35	13.567 4.81	8.200 4.98	11.367 0.00	13.550 9.66	
Delta Mean Pres	6.042 2.92	9.667 4.22	-16.375 41.06	8.167 0.00	7.333 6.59	
pct Return Pulse	111.842 22.39	101.905 13.08	116.063 7.58	60.526 0.00	111.162 11.77	
Pct Return Mean	101.482 2.75	97.815 4.48	96.725 3.49	-16.407 0.00	100.685 9.77	

TILT TABLE TESTS

Measure	Condition	SET 11	SET 12	SET 13	SET 14	SET 15
<u>Blood Pressure</u>						
Avg Sys Pre-Tilt	111.063 10.89.	107.750 4.27	125.375 4.19	121.625 4.39	128.000 4.24	
Avg Dia Pre-Tilt	57.313 11.30	55.317 5.39	75.350 6.38	67.125 4.31	67.500 8.11	
Pulse Pre-Tilt	53.750 11.54	52.333 6.31	50.125 6.17	54.500 6.91	60.500 5.61	
Mean Pres Pre-Tilt	75.229 9.75	72.861 4.98	91.958 4.96	85.292 2.84	87.667 6.55	
Avg Tilt Sys	113.175 7.19	116.100 2.44	125.050 7.29	118.200 7.28	126.812 8.62	
Min Tilt Sys	107.000 9.17	109.500 4.04	120.000 8.21	110.250 9.29	120.750 8.42	
Avg Tilt Dia	74.175 8.54	71.900 5.11	86.700 8.94	86.500 6.23	85.825 8.90	
Max Tilt Dia	79.750 8.08	76.500 5.82	93.750 8.66	95.250 8.66	90.000 7.07	
Avg Tilt Pulse	39.000 8.62	44.309 6.06	38.350 10.55	31.700 8.20	40.987 5.68	
Min Tilt Pulse	30.000 8.75	35.000 7.62	29.750 12.18	20.500 10.08	31.750 5.74	
Avg Tilt Mean	87.175 7.02	86.567 3.35	99.483 6.80	97.067 5.34	99.487 8.39	
Min Tilt Mean	81.625 7.38	83.444 4.53	94.667 8.59	92.917 4.65	95.417 11.21	
Avg Sys Post-Tilt	112.250 8.63	112.667 5.31	130.125 4.25	127.500 7.38	128.375 0.95	
Avg Dia Post-Tilt	61.313 11.28	57.333 4.45	80.500 7.93	74.625 5.62	68.000 7.33	
Delta Dia Avg	16.662 8.89	16.383 7.54	11.150 4.35	19.375 4.10	18.325 8.43	
Delta Dia Max	22.138 10.73	21.083 9.17	18.500 4.88	28.125 7.27	22.500 7.11	

TILT TABLE TESTS

TILT TABLE TESTS

Measure	Condition	Measure											
		SET 1			SET 2			SET 3			SET 4		
<u>Blood Pressure</u>		Condition		SET 5		SET 6		SET 7		SET 8		SET 9	
		Avg	Sys	Pre-Tilt	Avg	Sys	Pre-Tilt	Avg	Sys	Pre-Tilt	Avg	Sys	Pre-Tilt
Delta Pulse Avg	10.200 7.84	17.050 11.93	13.767 1.83	12.462 5.04	16.150 9.28	116.875 6.02	120.250 4.43	120.875 8.23	106.500 0.00	117.500 5.61			
Delta Pulse Max	18.125 9.15	27.083 9.47	27.250 2.06	23.000 1.60	27.000 14.35	59.500 10.47	57.125 4.89	65.750 3.07	68.500 0.00	64.125 3.20			
Pct Delta Pulse	67.672 17.97	57.048 15.22	53.923 7.67	49.720 1.81	56.666 16.27	57.375 11.48	63.125 8.76	55.125 5.68	38.000 0.00	53.375 3.50			
Delta Mean Avg	13.062 6.40	19.500 4.87	12.103 1.52	8.196 5.50	11.867 6.26	78.625 7.48	78.167 2.33	84.125 4.66	91.167 0.00	81.917 3.82			
Delta Mean Press	9.229 6.68	16.889 5.46	8.125 2.34	7.217 10.09	6.333 9.05	120.350 7.41	125.100 6.84	122.200 14.15	120.400 0.00	120.600 5.03			
Pct Return Pulse	113.129 26.82	104.127 14.28	110.579 3.82	119.175 17.17	102.858 6.22	Min Tilt Sys 9.93	110.000 9.93	117.500 9.85	89.250 59.85	115.000 0.00	110.750 10.34		
Pct Return Mean	99.360 8.31	101.230 4.17	99.619 2.50	94.304 4.06	99.307 5.18	Avg Tilt Dia 5.47	74.950 9.99	75.050 5.41	77.387 0.00	78.600 0.00	82.900 9.28		
						Max Tilt Dia 8.26	79.750 12.07	80.500 4.43	89.250 0.00	85.000 0.00	88.750 10.78		
						Avg Tilt Pulse 8.64	45.400 8.64	50.050 16.65	44.812 8.87	41.800 0.00	37.700 11.14		
						Min Tilt Pulse 14.82	35.250 17.15	40.000 20.30	30.250 0.00	30.000 0.00	25.250 17.80		
						Avg Tilt Mean 4.65	90.083 4.53	91.733 8.30	92.325 0.00	92.533 0.00	95.467 6.19		
						Min Tilt Mean 6.62	84.667 4.43	87.833 45.31	67.750 47.73	89.333 0.00	89.250 3.18		
						Avg Sys Post-Tilt 8.36	121.375 6.79	119.000 4.73	123.750 0.00	53.000 0.00	121.875 1.93		
						Avg Dia Post-Tilt 9.20	59.125 4.01	55.125 1.35	60.000 1.35	30.000 0.00	62.375 7.41		
						Delta Dia Avg 6.83	15.450 10.18	17.925 4.10	11.637 0.00	10.100 0.00	18.775 12.40		
						Delta Dia Max 5.74	20.250 12.17	23.375 7.45	23.500 0.00	16.500 0.00	24.625 13.59		

TILT TABLE TESTS

Measure

Condition	SET 11	SET 12	SET 13	SET 14	SET 15	SET 16	SET 17	SET 18	SET 19	SET 20
<u>Blood Pressure</u>										
Delta Pulse Avg	14.750 2.26	10.033 8.71	11.775 3.31	22.800 4.94	19.313 3.31	119.333 3.33	122.125 3.82	116.500 0.00	122.000 3.29	
Delta Pulse Max	23.750 10.93	17.313 12.37	20.375 12.35	31.000 5.34	28.750 6.33	70.333 4.51	66.750 9.91	61.500 14.68	75.750 0.00	
Pct Delta Pulse	56.551 15.56	68.422 20.21	53.594 24.01	36.446 15.11	52.517 8.67	40.000 5.20	61.750 10.81	55.250 14.12	55.000 0.00	46.250 3.20
Delta Mean Avg	11.946 6.49	13.706 4.28	13.706 5.37	13.775 3.45	11.821 7.24	86.667 3.18	87.333 8.78	85.292 9.63	79.833 0.00	91.167 3.24
Delta Mean Pres	6.396 6.48	10.583 5.55	2.708 5.85	7.625 1.59	7.750 9.71	116.667 5.55	128.300 8.98	119.800 4.16	113.800 0.60	119.400 3.99
Pct Return Pulse	97.555 20.80	106.375 8.20	99.682 9.67	97.514 8.49	90.564 3.33	109.667 6.81	117.250 12.79	115.750 5.91	105.300 6.00	114.250 3.20
Pct Return Mean	104.368 6.76	104.202 7.22	105.476 2.21	100.108 4.17	100.659 3.7	84.400 5.20	83.200 11.69	82.950 5.23	78.000 0.00	85.350 6.81
Avg Tilt Pulse						Max Tilt Dia	90.000 4.58	88.750 9.36	82.000 6.85	93.500 0.00
Min Tilt Pulse						Avg Tilt Pulse	32.267 9.10	45.100 10.92	36.850 2.74	35.800 0.00
Avg Tilt Mean						Min Tilt Pulse	23.333 14.19	35.000 15.15	30.500 2.52	24.000 0.00
Avg Sys Post-Tilt						Avg Tilt Mean	95.156 2.97	98.233 9.57	95.233 4.72	99.933 0.00
Avg Dia Post-Tilt						Min Tilt Mean	90.778 3.37	92.750 11.69	91.250 4.41	84.333 0.00
Delta Dia Avg						Avg Sys Post-Tilt	124.933 2.36	127.000 9.47	122.875 6.05	121.500 0.00
Delta Dia Max						Avg Dia Post-Tilt	75.167 4.16	68.625 6.68	65.750 5.33	81.750 0.00

TILT TABLE TESTS

Measure

Condition	SET 11	SET 12	SET 13	SET 14	SET 15	SET 16	SET 17	SET 18	SET 19	SET 20
<u>Blood Pressure</u>										
Avg Sys Pre-Tilt						Avg Sys Pre-Tilt				
Avg Dia Pre-Tilt						Avg Dia Pre-Tilt				
Pulse Pre-Tilt						Pulse Pre-Tilt				
Mean Pres Pre-Tilt						Mean Pres Pre-Tilt				
Avg Tilt Sys						Avg Tilt Sys				
Min Tilt Sys						Min Tilt Sys				
Avg Tilt Dia						Avg Tilt Dia				
Max Tilt Dia						Max Tilt Dia				
Avg Tilt Pulse						Avg Tilt Pulse				
Min Tilt Pulse						Min Tilt Pulse				
Avg Tilt Mean						Avg Tilt Mean				
Avg Sys Post-Tilt						Avg Sys Post-Tilt				
Avg Dia Post-Tilt						Avg Dia Post-Tilt				
Delta Dia Avg						Delta Dia Avg				
Delta Dia Max						Delta Dia Max				

TILT TABLE TESTSTILT TABLE TESTS

Measure	Condition	SET 16	SET 17	SET 18	SET 19	SET 20	Measure	Condition	SET 21	SET 22	SET 23	SET 24	SET 25
<u>Blood Pressure</u>													
Delta Pulse Avg		16.733 5.25	16.650 5.42	18.400 11.92	19.200 0.00	16.200 8.63	Avg Sys Pre-Tilt	104.500 3.37	108.250 4.56	116.125 6.68	110.813 2.94	108.542 7.77	
Delta Pulse Max		25.667 10.69	26.750 6.46	24.750 11.89	31.000 0.00	21.500 10.49	Avg Dia Pre-Tilt	61.125 7.65	59.625 9.21	67.000 4.56	56.188 11.17	50.750 6.27	
Pct-Delta Pulse		16.456 25.56	55.138 18.62	57.032 9.61	43.636 0.00	53.855 22.25	Pulse Pre-Tilt	43.375 9.25	48.625 9.58	49.125 6.71	54.625 10.53	57.792 9.51	
Delta Mean Avg		8.489 1.58	10.900 1.11	9.942 7.25	10.100 0.00	8.200 4.97	Mean Pres Pre-Tilt	75.583 4.88	75.833 6.47	83.375 4.33	74.396 9.56	70.014 5.13	
Delta Mean Pres		4.111 0.25	5.417 4.09	5.958 7.44	4.500 0.00	5.083 6.10	Avg Tilt Sys	105.200 11.27	113.100 6.29	114.750 5.51	115.000 7.38	116.783 7.31	
Pct Return Pulse		101.627 4.65	94.748 6.16	107.626 24.05	96.364 0.00	79.115 9.97	Min Tilt Sys	100.500 8.70	105.500 8.54	105.750 4.27	109.063 9.34	110.583 6.35	
pct Return Mean		105.920 5.21	101.132 4.49	99.993 8.47	107.933 0.00	106.547 6.65	Avg Tilt Dia	67.425 13.57	71.850 8.02	75.200 6.39	72.850 7.85	71.533 4.38	
							Max Tilt Dia	71.500 16.50	76.000 8.04	78.750 6.02	78.438 7.21	76.417 4.60	
							Avg Tilt Pulse	37.775 5.54	41.250 5.00	39.550 1.54	42.150 8.79	45.250 10.10	
							Min Tilt Pulse	32.250 8.56	31.500 4.80	29.500 8.19	33.688 10.13	35.583 9.09	
							Avg Tilt Mean	80.017 12.66	85.600 7.10	88.383 6.07	86.900 6.49	86.617 2.82	
							Min Tilt Mean	76.250 9.95	81.667 5.96	84.250 3.18	82.208 7.04	83.750 3.62	
							Avg Sys Post-Tilt	105.545 4.75	111.750 4.21	114.250 3.18	113.063 9.66	111.958 5.89	
							Avg Dia Post-Tilt	55.750 3.80	57.375 7.72	63.750 6.44	56.844 11.90	51.792 6.98	
							Delta Dia Avg	6.300 11.10	12.225 2.43	8.200 5.75	16.662 8.43	20.783 7.74	
							Delta Dia Max	10.375 12.80	16.375 3.47	11.700 6.61	22.250 10.14	25.667 8.51	

TILT TABLE TESTSTILT TABLE TESTS

Measure	Condition	SET 21	SET 22	SET 23	SET 24	SET 25	Measure	Condition	SET 26	SET 27	SET 28	SET 29	SET 30	
<u>Blood Pressure</u>														
Delta Pulse Avg	5.600 7.68	7.375 .8.03	9.575 7.94	12.475 9.59	12.542 11.02	12.542 11.02	Avg Sys Pre-Tilt	122.250 9.50	119.563 4.44	122.625 5.77	117.929 4.35	124.375 8.72		
Delta Pulse Max	11.125 8.87	17.125 11.46	19.625 14.90	20.938 10.16	22.208 11.67	22.208 11.67	Avg Dia Pre-Tilt	70.563 6.24	67.938 5.78	64.375 11.21	64.143 9.72	61.938 8.88		
Pct Delta Pulse	75.918 19.45	67.092 18.22	62.445 23.44	62.112 17.22	62.737 18.08	62.737 18.08	Pulse Pre-Tilt	51.688 5.69	51.625 9.20	60.250 10.83	53.786 9.74	62.438 9.14		
Delta Mean Avg	4.433 11.51	9.767 2.53	5.008 3.26	12.504 6.25	16.603 5.59	16.603 5.59	Mean Pres Pre-Tilt	87.792 6.26	85.146 3.17	84.058 8.30	82.071 7.06	82.750 7.70		
Delta Mean Pres	0.667 9.69	5.833 2.40	0.875 1.96	7.813 6.52	13.736 6.20	13.736 6.20	Avg Tilt Sys	123.550 9.40	117.362 6.38	124.581 7.13	118.771 6.37	126.700 7.58		
Pct Return Pulse	117.857 19.33	112.665 9.73	102.801 7.12	105.342 24.54	105.251 11.17	105.251 11.17	Min Tilt Sys	118.000 9.07	197.625 10.20	118.375 6.52	109.857 8.05	117.375 10.57		
Pct Return Mean	95.988 6.43	99.678 2.68	96.717 4.05	101.864 7.76	102.716 5.84	102.716 5.84	Avg Tilt Dia	84.633 7.39	83.800 8.28	82.162 8.94	79.000 7.03	79.125 10.97		
<u>Min Tilt Pulse</u>														
Max Tilt Dia							Max Tilt Dia	91.000 7.54	91.750 10.54	87.500 6.59	84.143 8.43	84.625 10.93		
<u>Avg Tilt Pulse</u>							Avg Tilt Pulse	38.917 8.03	33.994 11.29	42.419 8.62	39.771 10.69	47.575 13.40		
<u>Avg Tilt Mean</u>							Avg Tilt Mean	97.606 7.18	95.131 5.54	96.302 7.37	92.257 4.59	94.983 7.75		
<u>Min Tilt Pulse</u>							Min Tilt Pulse	29.375 9.10	23.125 12.32	32.375 6.41	30.143 14.75	37.500 15.26		
<u>Avg Sys Post-Tilt</u>							Avg Sys Post-Tilt	126.438 11.05	122.875 7.52	125.188 5.76	122.857 6.34	123.000 8.75		
<u>Avg Dia Post-Tilt</u>							Avg Dia Post-Tilt	72.125 11.79	67.813 9.20	64.188 13.11	66.000 11.03	61.875 8.83		
Delta Dia Avg							Delta Dia Avg	14.071 4.16	15.862 6.41	17.787 7.92	14.857 5.25	17.187 6.93		
Delta Dia Max							Delta Dia Max	20.438 4.52	23.813 7.49	23.125 7.72	20.000 4.79	22.666 8.23		

TILT TABLE TESTS

Measure	Condition	SET 26	SET 27	SET 28	SFT ^a	29	SET 30
<u>Blood Pressure</u>							
Delta Pulse Avg	12.771	17.631	17.831	14.014	14.863		
	7.19	6.75	7.11	11.04	11.81		
Delta Pulse Max	22.313	28.500	27.875	23.613	24.938		
	8.46	7.7	10.31	11.90	13.56		
Pct Delta Pulse	56.758	43.084	54.607	54.737	59.548		
	16.78	17.13	12.32	23.63	21.15		
Delta Mean Avg	9.814	9.985	11.844	10.186	12.233		
	4.40	4.66	6.28	3.00	3.53		
Delta Mean Pres	5.417	2.604	7.042	5.214	7.542		
	5.05	13.81	8.72	2.31	4.47		
Pct Return Pulse	105.130	108.345	101.211	107.664	98.326		
	8.96	17.07	4.95	16.96	10.21		
Pct Return Mean	102.548	101.206	99.983	103.384	99.474		
	3.82	8.28	4.14	1.29	4.51		

TILT TABLE TESTS

Measure	Condition	SET 31	SET 32	SET 33
<u>Blood Pressure</u>				
Avg Sys Pre-Tilt	121.500	111.500	119.750	
	5.58	7.07	4.89	
Avg Dia Pre-Tilt	66.313	65.000	69.938	
	9.45	4.95	6.99	
Pulse Pre-Tilt	55.188	46.500	49.813	
	9.96	12.02	4.91	
Mean Pres Pre-Tilt	84.708	80.500	86.542	
	7.03	0.94	5.93	
Avg Tilt Sys	121.000	117.100	120.000	
	9.74	4.67	4.25	
Min Tilt Sys	102.500	110.000	112.500	
	41.84	7.07	7.33	
Avg Tilt Dia	80.169	78.300	86.125	
	5.75	0.42	8.29	
Max Tilt Dia	88.250	83.500	91.125	
	5.44	2.12	8.20	
Avg Tilt Pulse	40.831	38.800	33.875	
	7.42	4.24	9.66	
Min Tilt Pulse	30.375	27.000	25.000	
	13.39	4.24	13.22	
Avg Tilt Mean	93.779	91.233	97.417	
	6.44	1.84	5.58	
Min Tilt Mean	79.500	86.833	92.750	
	32.34	3.54	5.59	
Avg Sys Post-Tilt	123.313	87.250	124.750	
	5.05	48.44	3.62	
Avg Dia Post-Tilt	62.875	49.250	72.063	
	4.73	27.22	12.25	
Delta Dia Avg	13.856	13.300	16.187	
	8.02	4.53	9.75	
Delta Dia Max	21.938	18.500	21.188	
	8.78	2.83	10.49	

TILT TABLE TESTS

Measure

Condition

SET 31

SET 32

SET 33

Blood Pressure

Condition

SET 31

SET 32

SET 33

Delta Pulse Avg

Condition

SET 31

SET 32

SET 33

Delta Pulse Max

Condition

SET 31

SET 32

SET 33

Pct Delta Pulse

Condition

SET 31

SET 32

SET 33

Delta Mean Avg

Condition

SET 31

SET 32

SET 33

Delta Mean Pres

Condition

SET 31

SET 32

SET 33

Pct Return Pulse

Condition

SET 31

SET 32

SET 33

Pct Return Mean

Condition

SET 31

SET 32

SET 33

Average To

Condition

SET 31

SET 32

SET 33

Left Leg T15

Condition

SET 31

SET 32

SET 33

Right Leg T15

Condition

SET 31

SET 32

SET 33

Average T15

Condition

SET 31

SET 32

SET 33

TILT TABLE TESTS

Measure

Condition

SET 1

SET 2

SET 3

SET 4

SET 5

Limb Volume

Condition

Left Leg S1

Right Leg S1

Average S1

Left Leg S2

Right Leg S2

Average S2

Left Leg T0

Right Leg T0

Average T0

Left Leg T15

Right Leg T15

Average T15

TIFF TABLE TESTS

PRESSURE

Condition

SET 6

SET 7

SET 8

SET 9

SET 10

MEASURE

Condition

SET 11

SET 12

SET 13

SET 14

SET 15

Limb Volume

Condition	SET 6	SET 7	SET 8	SET 9	SET 10	SET 11	SET 12	SET 13	SET 14	SET 15
Left Leg S1	5.975 1.23	5.717 0.89	5.751 1.31	4.050 0.03	5.913 2.90	5.239 2.50	6.308 1.97	1.210 0.00	4.900 2.36	5.933 3.04
Right Leg S1	8.830 6.00	7.000 1.11	6.847 3.08	12.190 0.02	8.150 3.45	5.783 2.77	5.788 3.37	6.600 0.23	3.810 0.95	6.963 1.34
Average S1	3.231 3.90	4.769 3.22	4.724 3.63	8.075 0.00	5.274 3.58	5.272 2.39	6.046 1.57	1.821 2.23	3.627 3.11	4.836 3.40
Left Leg S2	0.145 0.03	0.142 0.02	0.145 0.04	0.140 0.01	0.196 0.00	0.114 0.03	0.115 0.03	0.117 0.06	0.092 0.01	0.110 0.04
Right Leg S2	0.152 0.02	0.140 0.04	0.155 0.01	0.190 0.00	0.130 0.04	0.164 0.03	0.117 0.02	0.137 0.05	0.097 0.01	0.127 0.04
Average S2	0.149 0.01	0.141 0.03	0.150 0.02	0.190 0.00	0.127 0.03	0.129 0.03	0.116 0.03	0.124 0.05	0.095 0.01	0.119 0.04
Left Leg To	2.112 0.46	2.137 0.23	2.050 0.38	1.630 0.00	2.357 0.84	2.174 0.56	2.318 0.23	2.217 0.81	2.537 0.45	2.502 0.87
Right Leg To	2.400 0.35	3.042 1.28	2.427 0.30	2.680 0.06	2.777 0.66	2.507 0.77	2.173 0.31	2.692 0.66	2.357 0.44	2.400 0.82
Average To	2.256 0.33	2.590 0.55	2.239 0.24	2.155 0.00	2.535 0.61	2.341 0.53	2.246 0.24	2.601 0.77	2.447 0.36	2.451 0.80
Left Leg T15	4.195 0.81	4.015 0.36	4.067 0.81	4.410 0.00	4.377 0.57	3.719 0.36	4.075 0.33	4.167 1.08	3.907 0.42	3.975 0.98
Right Leg T15	4.675 0.43	4.677 0.89	4.667 0.47	5.920 0.00	4.722 1.00	4.592 0.84	3.852 0.62	3.540 0.91	3.787 0.51	4.050 0.71
Average T15	4.435 0.48	4.349 0.53	4.367 0.50	5.165 0.00	4.424 0.77	4.156 0.48	3.963 0.42	4.354 0.67	3.847 0.37	4.012 0.79

TIFF TABLE TESTS

TIFF TABLE TESTSTIFF TABLE TESTS

Measure	Condition	SET 16	SET 17	SET 18	SET 19	SET 20	SET 21	SET 22	SET 23	SET 24	SET 25
	Limb Volume	Limb Volume									
Left Leg S1	Left Leg S1	4.025 0.19	5.273 1.28	5.297 0.92	5.270 0.06	5.177 0.53	5.112 0.81	4.883 1.61	0.000 96.76	5.584 2.05	5.693 1.83
Right Leg S1	Right Leg S1	6.300 2.76	8.657 1.28	5.602 2.21	5.310 0.06	5.557 1.59	5.050 1.63	5.710 2.27	5.030 0.00	6.141 2.21	5.662 1.59
Average S1	Average S1	6.438 3.01	5.226 3.64	5.550 1.36	5.115 0.06	4.867 0.82	5.180 0.99	3.972 3.08	1.257 2.51	4.921 2.66	5.747 1.55
Left Leg S2	Left Leg S2	0.120 0.02	0.125 0.03	0.127 0.04	0.090 0.06	0.110 0.37	0.160 0.02	0.140 0.02	0.100 0.01	0.119 0.03	0.133 0.04
Right Leg S2	Right Leg S2	0.113 0.02	0.137 0.03	0.140 0.03	0.130 0.06	0.127 0.06	0.167 0.02	0.145 0.02	0.125 0.01	0.144 0.03	0.129 0.03
Average S2	Average S2	0.132 0.02	0.131 0.03	0.131 0.03	0.134 0.06	0.115 0.06	0.164 0.02	0.142 0.02	0.112 0.01	0.131 0.03	0.133 0.03
Left Leg T0	Left Leg T0	1.890 0.06	2.282 0.60	2.147 0.19	1.350 0.09	2.082 0.17	1.552 0.67	1.642 0.49	1.267 0.21	2.205 0.61	2.261 0.44
Right Leg T0	Right Leg T0	2.593 0.42	2.287 0.26	2.212 0.63	1.970 0.06	2.115 0.45	1.987 0.42	1.982 0.31	2.142 0.24	2.497 0.61	2.222 0.29
Average T0	Average T0	2.242 0.26	2.285 0.35	2.180 0.71	1.910 0.01	2.099 0.31	1.770 0.50	1.812 0.38	1.705 0.22	2.341 0.51	2.212 0.35
Left Leg T15	Left Leg T15	3.623 0.32	4.132 1.07	4.000 0.61	2.970 0.00	3.612 0.66	3.873 0.76	3.587 0.90	2.540 0.30	3.937 0.67	4.159 0.46
Right Leg T15	Right Leg T15	4.000 2.10	4.387 0.71	4.292 1.04	4.060 0.00	3.675 1.04	4.555 0.78	4.025 0.49	3.745 0.37	4.639 0.71	3.912 -0.75
Average T15	Average T15	3.812 0.84	4.260 0.84	4.176 -0.79	3.515 0.00	3.647 0.84	4.219 0.74	3.806 0.68	3.342 0.30	4.280 0.56	4.045 0.53

TILT TABLE TESTS

Measure	Condition	SET 26	SET 27	SET 28	SET 29	SET 30	Condition	SET 31	SET 32	SET 33
Limb Volume	Limb Volume						Limb Volume			
Left Leg S1	Left Leg S1	3.370	4.688	5.610	5.000	5.495	Left Leg S1	5.606	3.485	4.221
		2.62	1.81	2.09	1.35	1.02		1.92	0.80	1.95
Right Leg S1	Right Leg S1	4.010	3.860	6.815	7.382	7.828	Right Leg S1	6.136	8.705	6.669
		0.67	0.03	2.35	2.15	1.51		2.27	1.80	2.68
Average S1	Average S1	2.067	2.820	4.659	6.606	4.996	Average S1	5.137	6.095	5.071
		2.46	2.70	3.19	3.68	3.19		2.57	2.80	2.41
Left Leg S2	Left Leg S2	0.123	0.101	0.110	0.134	0.134	Left Leg S2	0.136	0.140	0.123
		0.04	0.03	0.03	0.03	0.03		0.04	0.07	0.03
Right Leg S2	Right Leg S2	0.145	0.104	0.126	0.129	0.129	Right Leg S2	0.117	0.165	0.129
		0.07	0.02	0.03	0.02	0.03		0.02	0.07	0.03
Average S2	Average S2	0.132	0.102	0.118	0.141	0.136	Average S2	0.142	0.152	0.123
		0.06	0.02	0.03	0.02	0.03		0.03	0.05	0.03
Left Leg To	Left Leg To	2.119	2.427	2.254	2.017	2.210	Left Leg To	2.099	1.740	2.200
		1.09	0.69	0.70	0.35	0.33		0.28	0.16	0.52
Right Leg To	Right Leg To	2.280	2.451	2.257	2.483	2.665	Right Leg To	2.320	2.325	2.446
		0.75	0.41	0.58	0.36	0.95		0.77	0.50	0.53
Average To	Average To	2.279	2.439	2.256	2.250	2.437	Average To	2.209	2.032	2.317
		0.90	0.51	0.60	0.27	0.46		0.31	0.17	0.50
Left Leg T15	Left Leg T15	4.019	4.020	3.967	3.950	4.074	Left Leg T15	4.034	3.690	3.270
		1.11	0.63	0.69	0.68	0.71		0.67	1.02	0.69
Right Leg T15	Right Leg T15	6.342	4.090	4.032	4.386	4.532	Right Leg T15	4.480	4.990	4.199
		0.77	0.60	0.49	0.93	0.76		0.77	1.32	1.10
Average T15	Average T15	4.181	4.055	4.000	4.168	4.303	Average T15	4.257	4.340	4.034
		0.87	0.54	0.57	0.68	0.65		0.62	1.17	0.85

TILT TABLE TESTS

NEGATIVE PRESSURE TESTSNEGATIVE PRESSURE TESTS

Measure	Condition	SET 1	SET 2	SET 3	SET 4	SET 5	Measure	Condition	SET 6	SET 7	SET 8	SET 9	SET 10
Heart Rate							Heart Rate						
Avg Pre-NP	57.250	64.333	52.000	51.500	64.500	51.500	Avg Pre-NP	57.300	57.500	55.000	60.000	49.500	49.500
Avg Post-NP	4.40	13.97	7.12	9.98	16.68	9.57	Avg Post-NP	9.57	17.33	11.33	0.00	0.00	0.43
Avg Step I NP	51.965	62.046	52.819	50.847	63.569	57.917	Avg Step I NP	56.507	55.806	44.000	49.569	49.569	5.18
Avg Step II NP	2.80	12.55	7.54	7.01	11.41	11.30	Avg Step II NP	10.32	9.43	0.00	0.00	0.00	0.00
Avg Step III NP	57.299	65.197	54.542	52.236	66.511	61.097	Avg Step III NP	58.042	55.931	45.333	50.472	50.472	2.86
Avg Total NP	2.46	13.29	9.37	8.67	11.46	5.29	Avg Total NP	12.35	10.76	0.00	0.00	0.00	0.00
Max Hr NP	58.431	65.583	58.778	56.931	68.694	62.722	Max Hr NP	67.069	56.731	7.111	52.026	52.026	4.20
Avg Total NP	2.28	10.86	6.62	7.52	13.46	6.03	Avg Total NP	10.19	10.02	0.00	0.00	0.00	0.00
Avg Total NP	56.898	64.275	55.380	52.671	66.259	60.579	Avg Total NP	56.569	56.056	45.481	50.690	50.690	4.02
Max Hr NP	2.15	12.02	7.92	7.69	12.00	7.21	Max Hr NP	10.95	10.01	0.00	0.00	0.00	0.00
Max Hr NP	61.500	72.000	64.000	60.000	74.000	73.000	Max Hr NP	73.000	65.000	46.000	58.000	58.000	4.00
Avg Post-NP	56.000	66.000	56.000	59.000	71.500	63.500	Avg Post-NP	61.500	55.500	42.079	59.000	59.000	4.31
Delta Hr Avg	-0.352	-0.059	3.380	1.171	1.759	2.079	Delta Hr Avg	2.069	1.056	5.141	1.190	1.190	3.45
Delta Hr Max	2.80	2.81	1.57	3.91	8.01	5.32	Delta Hr Max	6.60	2.31	0.00	0.00	0.00	0.00
Pct Delta Hr Max	7.250	7.667	12.000	8.500	9.500	11.500	Pct Delta Hr Max	10.500	10.000	16.000	16.000	16.000	8.500
Pct Delta Hr Return	113.140	112.513	122.914	117.174	117.909	126.016	Pct Delta Hr Return	123.973	118.118	149.000	117.680	117.680	1.73
Pct Delta Hr Return	8.93	6.85	6.47	6.94	17.67	15.92	Pct Delta Hr Return	22.50	2.29	0.00	0.00	0.00	0.00
Pct Delta Hr Return	103.071	103.053	107.654	117.194	112.269	108.970	Pct Delta Hr Return	116.286	101.667	120.000	120.526	120.526	25.44
Pct Delta Hr Return	4.25	4.42	5.33	20.34	12.86	10.49	Pct Delta Hr Return	23.86	5.77	0.00	0.00	0.00	0.00

NEGATIVE PRESSURE TESTSNEGATIVE PRESSURE TESTS

Measure	Condition	SET 11	SET 12	SET 13	SPF 14	SET 15	Measure	Condition	SET 16	SET 17	SET 18	SPF 19	SET 20
Heart Rate							Heart Rate						
Avg Pre-NP		62.000	67.333	67.000	64.000	78.000	Avg Pre-NP		65.333	70.500	66.000	86.000	63.000
	E.17	7.97	7.75	8.79	9.52			16.74	11.82	8.00	8.00	8.00	12.70
Avg Step I NP		60.937	66.296	66.750	63.472	78.000	Avg Step I NP		65.167	71.347	66.875	84.111	63.986
	6.72	6.15	6.84	7.22	5.72			11.56	11.04	7.60	0.00	0.00	10.90
Avg Step II NP		61.500	68.516	67.944	70.653	79.222	Avg Step II NP		66.667	70.625	64.958	86.000	63.417
	6.13	5.34	6.65	8.42	5.68			11.56	11.25	7.67	0.00	0.00	9.72
Avg Step III NP		63.604	70.204	72.194	71.986	80.194	Avg Step III NP		73.389	71.542	66.079	86.000	67.083
	6.69	6.06	7.71	8.37	5.74			12.15	10.03	6.93	0.00	0.00	10.63
Avg Total NP		62.014	68.339	68.963	68.704	79.139	Avg Total NP		68.407	71.171	65.971	85.481	64.829
	5.60	5.74	6.97	7.40	5.55			9.96	10.70	7.46	0.00	0.00	10.23
Max Hr NP		70.000	76.333	77.000	80.000	85.000	Max Hr NP		80.000	79.000	74.000	92.000	71.000
	6.05	7.6	8.87	8.64	5.03			10.58	13.61	6.93	0.00	0.00	11.55
Avg Post-NP		65.250	70.667	69.500	69.000	78.000	Avg Post-NP		70.000	75.000	48.000	83.000	65.500
	4.77	10.25	6.40	7.39	6.32			8.72	12.70	32.78	0.00	0.00	11.12
Delta Hr Avg		0.01	1.005	1.963	4.704	1.139	Delta Hr Avg		3.074	0.671	-0.029	-0.219	1.829
	3.91	3.25	2.17	5.79	4.79			5.27	3.37	1.47	0.00	0.00	2.86
Delta Hr Max		8.000	9.000	10.000	16.000	7.000	Delta Hr Max		14.667	8.500	8.000	6.000	11.000
	6.41	6.54	4.32	7.83	7.57			13.01	3.00	2.31	0.00	0.00	7.58
Pct Delta Hr Max		113.898	114.318	115.052	125.861	109.823	Pct Delta Hr Max		125.011	112.02C	112.407	105.977	118.222
	12.24	11.36	6.36	13.26	10.24			22.13	3.55	4.37	0.00	0.00	5.95
Pct Delta Hr Retn		106.031	105.602	104.009	108.480	100.420	Pct Delta Hr Retn		109.042	106.406	71.299	102.326	104.656
	8.08	16.21	4.52	10.86	5.33			15.43	5.47	7.55	0.00	0.00	9.06

NEGATIVE PRESSURE TESTS

Measure	Condition	SET 21	SET 22	SET 23	SET 24	SET 25	SET 26	SET 27	SET 28	SET 29	SET 30
<u>Heart Rate</u>											
Avg Pre-NP		60.000 10.33	69.000 17.32	63.500 1.00	59.625 6.78	65.833 10.94	59.500 10.57	57.750 10.98	71.250 14.50	61.429 11.47	62.500 16.20
Avg Step I NP		60.625 9.28	67.750 16.89	62.681 1.47	57.951 3.85	67.171 9.68	Avg Step I NP 10.09	57.160 9.47	70.785 11.37	61.021 11.06	62.972 13.38
Avg Step II NP		62.167 12.52	68.744 17.10	61.186 2.46	59.399 5.01	66.955 9.81	Avg Step II NP 10.39	61.441 12.63	72.868 10.78	63.484 8.18	64.333 12.84
Avg Step III NP		63.028 12.54	68.778 18.08	65.139 1.33	61.017 4.45	67.894 8.72	Avg Step III NP 9.78	63.458 11.72	74.444 11.38	67.294 9.99	64.306 12.11
Avg Total NP		61.940 11.34	68.324 17.12	63.102 1.69	59.456 4.89	66.307 9.23	Avg Total NP 10.02	62.171 11.06	72.699 11.06	63.934 8.75	63.370 12.70
Max Hr NP		69.000 11.38	73.000 16.58	67.250 2.30	67.167 5.51	74.167 9.93	Max Hr NP 11.30	70.500 13.35	79.500 10.57	76.000 10.33	72.000 10.33
Avg Post-NP		67.000 13.71	69.500 18.06	66.000 3.65	60.625 6.01	68.333 11.28	Avg Post-NP 9.91	64.000 8.00	74.750 12.09	66.286 9.76	68.250 12.26
Delta Hr Avg		1.940 1.37	-0.676 -1.23	-0.398 -2.13	-0.169 3.29	0.473 2.95	Delta Hr Avg 1.90	2.937 4.95	1.449 6.12	2.505 4.86	1.370 4.91
Delta Hr Max		9.000 5.03	4.000 1.63	9.500 3.00	7.625 5.49	8.333 5.03	Delta Hr Max 4.14	12.250 6.63	8.250 7.29	14.571 9.71	9.500 4.99
Pct Delta Hr "ax"		114.633 6.39	105.768 1.84	115.020 5.01	113.519 10.36	113.416 8.99	Pct Delta Hr Max 7.28	118.983 10.78	121.669 14.05	113.866 14.05	117.997 15.99
Pct Delta Hr Return		111.310 5.52	100.351 2.73	101.907 7.10	102.051 7.47	104.327 11.41	Pct Delta Hr Return 6.97	112.837 15.80	106.344 11.10	109.001 11.59	112.346 11.59

NEGATIVE PRESSURE TESTSNEGATIVE PRESSURE TESTS

Measure	Condition	SET 31	SET 32	SET 33	Condition	SET 1	SET 2	SET 3	SET 4	SET 5
<u>Heart Rate</u>										
Avg Pre-NP	60.500	63.000	56.250		Avg Sys Pre-NP	107.688	112.333	115.625	116.750	117.500
Avg Step I NP	10.73	32.53	11.39		Avg Dia Pre-NP	8.51	7.37	12.37	3.66	8.81
Avg Step II NP	61.370	61.222	56.778		Avg Pulse Pre-NP	56.688	56.333	69.625	69.500	64.875
Avg Step III NP	9.89	28.60	11.04		Avg Mean Pulse Pre-NP	10.01	7.40	7.66	6.94	4.03
Avg Total NP	60.104	65.667	56.944		Total Sys Steps	51.000	57.000	46.000	47.250	52.625
Max Hr NP	10.0	28.76	9.59		Total Pulse Steps	9.16	8.67	5.55	4.19	8.53
Avg Hr NP	61.255	56.556	59.556		Total Mean Steps	73.687	75.333	84.958	85.250	82.417
Avg Post-NP	9.50	27.50	10.99		Sys Post-NP	8.51	3.78	9.13	5.72	4.53
Avg Total NP	61.013	65.481	57.759		Dia Post-NP	106.187	110.503	112.792	114.333	117.333
Max Hr NP	10.46	25.46	11.71		Pulse Post-NP	9.24	7.86	11.21	7.50	9.87
Avg Post-NP	51.750	68.000	62.250		Min Systolic	49.146	52.556	39.833	42.542	47.375
Delta Hr Avg	0.513	2.481	1.509		Max Diastolic	10.84	9.97	5.13	7.02	8.34
Delta Hr Max	1.89	4.24	2.96		Min Pulse	75.424	75.516	86.236	85.372	85.750
Pct Delta Hr Avg	4.56	23.35	7.78		Max MPP	6.81	7.78	10.92	11.43	6.39
Pct Delta Hr Return	86.483	111.163	112.591		Min MPP	75.021	76.750	85.083	85.792	88.375
	35.31	12.56	19.61		Delta Pulse Max	6.58	6.11	10.10	4.24	11.66

NEGATIVE PRESSURE TESTS

Measure	Condition	SET 1	SET 2	SET 3	SET 4	SET 5	SET 6	SET 7	SET 8	SET 9	SET 10
	Condition	causture									
	Blood Pressure	Blood Pressure									
Pct Delta Pulse Max	81.609 8.31	80.170 11.53	72.58; 15.21	66.936 21.43	75.629 2.91	Avg sys Pre-NP 7.66	116.875 6.33	115.750 6.34	116.125 0.00	107.000 0.00	111.000 1.42
Delta BP Mean Avg	1.736 3.41	3.213 3.15	1.278 4.71	0.722 3.53	3.333 2.24	Avg dia Pre-NP 6.81	63.750 5.96	65.125 4.53	53.000 0.00	53.000 0.00	68.875 9.63
Delta BP Mean Max	-1.229 3.25	-3.667 -1.07	-3.208 5.81	-3.000 3.89	-1.500 1.48	Avg Pulse Pre-NP 3.61	52.375 10.37	51.00 9.37	51.000 0.00	51.000 0.00	55.125 11.02
Pct Return Pulse	106.928 22.09	90.112 11.35	90.438 13.79	93.164 18.75	94.501 20.43	%wr Mean Pulse Pre-NP 81.758 6.90	20.833 3.63	82.125 2.76	77.667 0.00	83.917 6.43	
Pct Return BP Mean	102.132 4.61	101.867 5.39	100.140 5.08	100.916 7.42	106.983 8.55	Total Sys Stens 9.39	116.042 9.97	116.250 9.67	120.250 0.00	108.667 0.00	111.417 5.33
						Total Pulse Stens 5.12	53.375 12.92	51.208 8.58	52.500 0.00	52.500 0.00	52.792 7.86
						Total Mean Stens 6.67	80.667 1.00	86.111 3.05	80.333 7.00	80.333 7.00	81.556 3.45
						Sys Post-NP 6.75	116.750 7.11	113.000 8.72	120.750 0.00	106.500 0.00	117.750 9.73
						Dia Post-NP 6.75	66.000 5.12	62.750 6.71	65.525 0.00	66.000 0.00	72.500 5.79
						Pulse Post-NP 7.17	50.250 12.74	55.125 9.56	50.500 0.00	50.500 0.00	55.250 1.31
						Mean Post-NP 7.14	92.250 2.38	79.500 4.11	87.000 0.00	79.500 0.00	87.583 2.91
						Min Systolic 6.55	109.750 7.00	110.500 9.02	111.750 9.02	100.000 0.00	108.250 7.59
						Max Diastolic 6.40	73.750 6.99	69.250 6.99	76.667 5.51	72.000 0.000	75.750 5.71
						Min pulse 3.83	49.000 13.45	45.250 5.99	41.000 0.00	37.000 0.00	37.750 9.60
						In BP 7.80	79.043 7.80	76.917 2.18	81.417 3.18	75.333 0.00	79.833 3.11
						Delta Pulse NP 0.25	13.125 3.43	10.000 6.04	7.000 0.00	7.375 2.44	

NEGATIVE PRESENCE TESTS

Measure	MEAN PRESENCE TESTS					NEGATIVE PRESENCE TESTS				
	Condition	SET 11	SET 12	SET 13	SET 14	Condition	SET 11	SET 12	SET 13	SET 14
<u>Blood Pressure</u>										
Pct Delta Pulse Tax	75.18	30.371	81.078	85.091	93.907	Avg Sys pre-NP	100.63%	110.167	122.000	120.625
	2.18	16.96	5.31	0.00	9.55		10.03	3.82	2.24	4.01
Delta BP "mean Avg	2.611	-9.157	3.986	2.667	0.630	Avg Dia pre-NP	60.313	59.833	85.175	76.375
	2.61	3.30	4.73	0.00	7.96		6.66	3.59	6.30	2.06
Delta BP "mean Tax	-2.375	-3.917	-0.708	-2.333	-4.063	Avg Pulse pre-NP	45.377	51.333	37.875	44.250
	5.53	2.68	5.26	0.00	1.02		5.73	3.53	5.73	5.19
Pct Return Pulse	91.46	95.120	108.725	92.015	101.187	Avg Near Pulse pre-NP	75.771	75.911	48.750	91.125
	8.23	7.72	13.77	0.00	25.04		6.65	3.27	5.01	4.48
Pct Return BP "mean	100.965	99.637	102.418	102.361	101.826	Total Sys Steps	110.771	108.805	110.917	110.552
	1.44	3.52	7.82	0.00	3.77		9.71	5.57	9.91	7.17
Total Pulse Steps						Total Pulse Steps	96.333	49.361	39.208	39.517
							10.22	2.22	3.71	5.51
Total Mean Steps						Total Mean Steps	77.082	75.390	92.778	92.264
							5.75	4.25	5.05	7.20
Sys Post-NP	112.138	109.563	122.250	122.375	126.375					
	9.77	7.71	3.97	3.71	7.40					
Dia Post-NP	50.500	58.167	80.250	79.702	72.375					
	3.32	6.37	9.45	2.69	6.01					
Pulse Post-NP	51.938	50.333	42.000	42.675	54.000					
	10.67	7.89	3.53	5.23	5.23					
Mean Post-NP	77.412	75.278	52.250	93.792	90.375					
	4.08	5.30	7.28	2.75	5.07					
'in Systolic	105.375	101.937	115.250	115.500	117.750					
	11.19	3.86	2.75	6.51	7.57					
Max Diastolic	6.333	64.661	85.000	85.667	78.750					
	7.09	5.16	6.68	3.79	3.09					
'in Pulse	32.125	43.733	32.000	33.250	33.066					
	11.41	5.00	5.83	6.49	7.57					
'in MPP	76.292	72.667	88.417	89.251	85.063					
	5.21	3.82	4.79	2.94	4.46					
Delta Syst Max	5.250	7.593	5.875	11.000	6.875					
	7.66	6.88	6.56	3.76	8.61					

NEGATIVE PRESSURE TESTS

Measure	Condition	SET 11	SET 12	SET 13	SET 14	SET 15
<u>Blood Pressure</u>						
Pct Delta Pulse Max	89.5 : 1.20	85.913 : 13.02	85.110 : 1.37	74.859 : 8.98	84.017 : 13.59	
Delta BP Mean Avg	1.111 : 3.39	-0.046 : 0.69	-3.972 : 1.13	2.139 : 1.59	3.264 : 1.59	
Delta BP Mean Max	-2.779 : 3.58	-3.272 : 2.92	-8.333 : 2.33	-1.875 : 2.42	-0.458 : 0.88	
Pct Return Pulse	106.580 : 17.20	100.56 : 12.54	112.109 : 5.07	96.935 : 15.05	105.228 : 15.05	
Pct Return RP Mean	101.65 : 2.58	99.165 : 6.18	97.330 : 2.63	102.919 : 1.56	105.702 : 3.10	

NEGATIVE PRESSURE TESTS

Measure	Condition	SET 16	SET 17	SET 18	SET 19	SET 20
<u>Blood Pressure</u>						
Avg Sys Pre- ^{NP}		110.667 : 3.21	122.750 : 2.51	117.750 : 3.67	116.000 : 0.00	117.000 : 2.56
Avg Dia Pre- ^{NP}		75.000 : 4.00	65.500 : 6.67	69.625 : 7.52	64.500 : 0.06	75.375 : 4.52
Avg Pulse Pre- ^{NP}		43.667 : 6.81	57.250 : 8.27	48.125 : 8.56	51.500 : 0.00	41.625 : 5.49
Avg Mean Pulse Pre- ^{NP}		89.556 : 1.95	97.583 : 5.35	95.667 : 5.08	81.567 : 0.00	89.250 : 3.02
Total Sys Steps		117.111 : 5.37	122.625 : 3.60	117.667 : 3.23	115.167 : 0.00	119.083 : 2.43
Total Pulse Steps		122.167 : 5.53	124.258 : 5.59	128.167 : 5.39	120.833 : 0.00	120.125 : 7.29
Total Mean Steps		89.000 : 1.78	85.996 : 1.43	85.556 : 6.08	81.278 : 0.00	92.333 : 3.55
Sys Post-NP		120.500 : 3.27	124.375 : 3.97	117.375 : 3.82	116.500 : 0.00	119.375 : 3.90
Dia Post-NP		76.667 : 2.15	62.375 : 7.85	68.000 : 8.92	64.000 : 0.00	76.500 : 7.15
Pulse Post- ^{NP}		43.933 : 2.31	56.000 : 6.26	49.375 : 12.36	52.300 : 0.00	42.875 : 9.11
Mean Post- ^{NP}		91.278 : 3.15	87.042 : 6.07	82.450 : 2.89	81.500 : 0.00	90.792 : 2.55
Min Systolic		113.000 : 3.36	119.250 : 3.10	114.750 : 4.35	111.000 : 0.00	113.500 : 3.36
Max Diastolic		81.500 : 2.12	71.000 : 7.87	74.000 : 9.38	66.000 : 0.00	84.00 : 5.94
Min Pulse		36.667 : 4.93	49.750 : 4.03	44.750 : 8.77	49.000 : 0.00	32.750 : 5.74
Min MAP		86.667 : 2.19	84.117 : 6.24	82.500 : 6.02	80.333 : 0.00	87.833 : 5.67
Delta Pulse Max		7.000 : 4.45	7.500 : 2.59	3.375 : 2.59	2.50 : 0.00	8.875 : 2.56

NEGATIVE PRESSURE TESTS

Measure	Condition	SET 16	SET 17	SET 18	SET 19	SET 20
Blood Pressure	Condition	SET 21	SET 22	SET 23	SET 24	SET 25
pct Delta Pulse Max	94.220	87.67	92.301	95.176	78.453	
Delta SP Mean %var	-0.556	1.103	-0.111	-0.399	3.083	7.09
Delta SP Mean %var	-3.42	2.32	2.01	2.00	1.73	
Delta SP Mean %var	-2.889	-0.167	-3.167	-1.333	1.417	
Pct Return Pulse	101.782	99.518	101.793	101.942	102.679	
Pct Return Br Mean	101.994	102.913	98.642	99.796	101.71	
Pct Return Br Mean	5.39	3.55	3.53	0.61	3.31	

NEGATIVE PRESSURE TESTS

Measure	Condition	SET 21	SET 22	SET 23	SET 24	SET 25
Blood Pressure	Condition	SET 21	SET 22	SET 23	SET 24	SET 25
Avg Sys Pre-NP	107.375	108.00	105.525	108.688	111.750	2.90
Avg Dia Pre-NP	61.125	61.500	65.500	58.500	57.533	7.77
Avg Pulse Pre-NP	46.250	47.000	44.125	50.188	54.167	8.15
Avg Mean Pulse Pre-NP	76.542	77.167	80.208	75.229	75.639	5.21
Total Sys Steps	105.750	109.542	110.833	109.479	109.69	5.43
Total Pulse Steps	43.833	45.000	47.083	49.20	50.956	11.20
Total Mean Steps	76.528	79.542	81.141	76.353	75.722	6.19
Sys Post-NP	106.625	110.375	112.375	111.750	110.208	7.98
Dia Post-NP	62.125	65.375	65.500	58.750	58.917	9.78
Pulse Post-NP	47.500	47.500	46.875	53.000	51.297	11.30
Mean Post-NP	76.958	80.708	81.125	76.417	76.014	7.49
Min Systolic	99.500	105.750	107.500	107.313	105.090	5.00
Max Diastolic	66.000	68.000	73.867	63.717	63.909	10.03
Min Pulse	34.500	38.750	37.250	42.939	47.833	12.71
Min NBP	73.333	76.083	77.117	73.375	72.167	6.87
Delta Pulse Max	11.750	8.250	6.375	7.250	9.333	7.9

MEANATIVE PRESENTATION

Measure	Condition	SET 21	SET 22	SET 23	SET 24	SET 25
<u>Blood Pressure</u>						
Pct Delta Pulse Max	14.5%	72.736	92.166	80.743	85.578	83.041
Delta BP Mean Inv	-0.314	10.96	11.94	12.01	12.19	12.19
Pct Delta BP Mean Max	1.32	2.375	1.236	1.626	0.083	3.33
Delta BP Mean Max	-3.208	-1.083	-2.792	-1.851	-3.472	-3.38
Pct Return Pulse	95.609	94.229	107.651	106.756	95.494	95.494
Pct Return BP Mean	15.17	11.21	26.08	19.12	14.76	14.76
	3.14	3.9%	d.09	d.42	5.70	5.70

NEGATIVE PRESSURE TESTS

Measure	Condition	SET 26	SET 27	SET 28	SET 29	SET 30
Blood Pressure						
Avg Sys Pre-NP		118.813 o .22	118.688 o .11	118.613 o .55	117.643 o .51	119.750 o .03
Avg Dia Pre-NP		76.875 o .10	72.938 o .60	66.563 o .59	68.571 o .59	64.438 o .97
Avg Pulse Pre-VP		61.938 o .80	45.750 o .65	52.250 o .29	49.071 o .89	55.813 o .89
Avg Mean Pulse Pre-NP		90.854 o .28	88.187 o .48	83.979 o .83	84.929 o .62	82.708 o .68
Total Sys Steps		115.856 o .15	116.937 o .25	119.323 o .14	116.500 o .34	119.437 o .19
Total Pulse Steps		39.521 o .58	40.979 o .08	<8.116 o .30	45.476 o .73	51.167 o .26
Total Mean Steps		89.567 o .62	89.618 o .07	87.279 o .23	86.183 o .50	83.326 o .12
Sys Post-NP		117.500 o .87	118.625 o .83	123.875 o .05	117.214 o .19	118.688 o .08
Dia Post-NP		75.750 o .87	75.375 o .97	72.125 o .04	70.571 o .39	65.563 o .17
Pulse Post-NP		41.950 o .51	41.250 o .72	51.750 o .99	46.644 o .26	53.125 o .86
Mean Post-NP		89.667 o .51	89.792 o .35	89.375 o .39	86.119 o .22	83.271 o .87
Min Systolic		111.875 o .62	111.250 o .74	115.350 o .23	111.144 o .55	114.875 o .92
Max Diastolic		82.250 o .00	81.571 o .91	75.875 o .36	76.333 o .64	70.125 o .96
Min Pulse		32.500 o .24	32.125 o .56	41.375 o .21	38.571 o .31	47.500 o .50
Max NBP		85.983 o .26	85.750 o .37	83.000 o .17	82.333 o .01	80.667 o .90
Delta Pulse Max		9.438 o .75	9.625 o .25	9.875 o .25	10.875 o .50	10.500 o .25

INITIVE PULSE RATE

Condition	7-2-76	8-17-76	8-18-76	8-19-76	8-20-76
<u>Mean Measure</u>					
Pct Delta Pulse Pre	74.97	76.398	76.923	76.057	86.997
	15.03	15.79	15.1	15.58	15.16
Delta Mean "Pre"	-1.37	1.133	3.293	1.251	0.618
	3.10	2.55	1.80	3.19	2.70
Delta "Max" "	+5.771	-2.038	-9.979	-2.595	-2.042
	6.93	3.96	1.5	2.28	3.1
tot return "vlnr"	101.279	95.050	99.865	95.973	96.973
	16.82	12.37	17.58	11.75	9.33
Pct "return" "mean"	99.735	101.917	106.293	101.405	110.675
	1.10	5.05	5.98	3.32	2.05

INITIATIVE PRESSURE MEASUREMENTS

Measure	Condition	SET 31	SET 32	SET 33
<u>Blood Pressure</u>				
Avg Sys Pre-IP		116.938	111.500	115.500
		.86	6.36	3.71
Avg Dia Pre-IP		61.375	63.750	72.125
		6.23	1.06	7.78
Avg Pulse Pre-IP		49.563	47.750	43.375
		8.45	5.30	8.27
Avg Mean Pulse Pre-IP		83.896	79.667	86.983
		1.23	2.83	5.76
Total Sys Stros		118.958	111.917	116.750
		6.21	4.60	6.58
Total Pulse Stros		49.687	46.667	42.458
		8.48	5.89	7.45
Total Mean Stros		85.833	80.806	88.144
		4.46	0.67	5.27
Sys Post-SP		119.063	111.500	119.563
		6.49	7.07	6.95
Dia Post-IP		66.813	65.000	7.500
		6.72	1.41	6.39
Pulse Post-IP		52.250	46.500	44.063
		10.72	8.79	11.20
Mean Post-IP		86.229	80.500	89.187
		4.32	1.41	3.93
Min Systolic		117.750	107.000	116.875
		5.37	9.60	5.17
Max Diastolic		75.143	69.000	79.875
		7.49	4.24	6.98
"in Pulse		42.875	43.000	35.250
		7.20	8.42	7.80
"in MRP		81.938	77.933	93.833
		4.69	3.54	6.02
Delta Pulse Max		6.688	4.750	8.125
		5.57	3.18	3.46

NEGATIVE PRESSURE TESTS

Measure	SET 31	SET 32	SET 33	Measure	SET 1	SET 2	SET 3	SET 4	SET 5
Condition				Condition					
<u>Blood Pressure</u>									
Pct Delta Pulse Max	96.95%	89.61%	81.22%	DV/DP1 Left Leg	0.055	0.230	0.345	0.332	0.252
	9.22	7.82	8.33		0.38	0.27	0.17	0.45	0.22
Delta BP Mean Avg	1.937	1.139	1.861	DV/DP1 Right Leg	-0.073	-0.028	-0.070	-0.025	-0.002
	0.01	2.16	3.12		0.08	0.04	0.03	0.05	0.11
Delta BP Mean Max	-1.938	-1.833	-2.750	DV/DP2 Left Leg	0.340	0.257	0.367	0.447	0.317
	3.96	0.71	3.78		0.20	0.10	0.16	0.22	0.11
Pct Return Pulse	105.259	96.99%	101.03%	DV/DP2 Right Leg	-0.019	-0.017	-0.057	-0.008	-0.052
	12.09	7.00	20.01		0.16	0.03	0.07	0.01	0.04
Pct Return SP Mean	100.53	101.07%	103.27%	T15 Left Leg	-0.225	0.270	0.457	0.302	0.142
	6.01	1.81	6.36		0.44	0.25	0.47	0.72	0.22
Pct Return SP Mean	0.57	0.43	0.64	T15 Right Leg	-0.544	-0.612	-0.317	-0.560	-0.770
					0.52	0.49	0.42		

NEGATIVE PRESSURE TESTS

Measure	SET 1	SET 2	SET 3	Measure	SET 1	SET 2	SET 3	Measure	SET 1	SET 2	SET 3
Condition				Condition				Condition			
<u>Leg Volume</u>											
DV/DP1 Left Leg	0.055	0.230	0.345	DV/DP1 Right Leg	0.073	-0.028	-0.070	DV/DP2 Left Leg	0.340	0.257	0.367
	0.38	0.27	0.17		0.08	0.04	0.03		0.20	0.10	0.16
DV/DP1 Right Leg	-0.073	-0.028	-0.070	DV/DP2 Right Leg	-0.019	-0.017	-0.057	DV/DP2 Left Leg	-0.225	0.270	0.457
	0.08	0.04	0.03		0.16	0.03	0.07		0.44	0.25	0.47
T15 Left Leg	-0.225	0.270	0.457	T15 Right Leg	-0.544	-0.612	-0.317	T15 Left Leg	-0.52	0.49	0.42
	0.44	0.25	0.47		0.57	0.43	0.52				

NEGATIVE PRESSURE TESTS

Measure

Condition	SFT 6	SET 7	SET 8	SFT 9	SET 10	Condition	SFT 11	SET 12	SET 13	SET 14	SFT 15
Leg Volume	Leg Volume										
DV/DP1 Left Leg	0.446	0.402	0.102	0.180	0.417	DV/DP1 Left Leg	0.367	0.175	0.393	0.250	0.400
DV/DP1 Right Leg	0.25	0.17	0.26	0.00	0.12	DV/DP1 Right Leg	0.26	0.24	0.29	0.20	0.17
DV/DP2 Left Leg	-0.057	-0.013	0.028	-0.050	-0.070	DV/DP2 Left Leg	-0.070	-0.027	0.012	-0.015	-0.012
DV/DP2 Right Leg	0.03	0.06	0.08	0.00	0.06	DV/DP2 Right Leg	0.12	0.06	0.03	0.06	0.09
T15 Left Leg	0.452	0.333	0.315	0.289	0.387	T15 Left Leg	0.336	0.305	0.440	0.320	0.322
T15 Right Leg	0.08	0.07	0.09	0.00	0.13	T15 Right Leg	0.20	0.15	0.16	0.11	0.07
T15 Left Leg	1.195	0.517	0.003	0.560	0.747	T15 Left Leg	0.00	0.074	0.925	0.242	0.425
T15 Right Leg	0.92	0.98	0.59	0.60	0.63	T15 Right Leg	0.92	0.52	0.99	0.60	0.78

NEGATIVE PRESSURE TESTS

Measure

Condition	SFT 11	SET 12	SET 13	SFT 14	SFT 15
Leg Volume	Leg Volume				
DV/DP1 Left Leg	0.367	0.175	0.393	0.250	0.400
DV/DP1 Right Leg	0.26	0.24	0.29	0.20	0.17
DV/DP2 Left Leg	-0.070	-0.027	0.012	-0.015	-0.012
DV/DP2 Right Leg	0.12	0.06	0.03	0.06	0.09
T15 Left Leg	0.336	0.305	0.440	0.320	0.322
T15 Right Leg	0.20	0.15	0.16	0.11	0.07

NEGATIVE PRESSURE TESTS

Measure

Condition

SET 16

SFT 17

SET 18

SFT 19

SET 20

Measure

Condition

SET 21

SFT 22

SET 23

SFT 24

SET 25

NEGATIVE PRESSURE TESTS

Measure

Condition

SET 21

SFT 22

SET 23

SFT 24

SET 25

Leg Volume

DV/DP1

Left Leg

DV/DP1

Right Leg

DV/DP2

Left Leg

DV/DP2

Right Leg

T15

Left Leg

T15

Right Leg

Leg Volume

DV/DP1

Left Leg

DV/DP1

Right Leg

DV/DP2

Left Leg

DV/DP2

Right Leg

T15

Left Leg

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Leg Volume

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DV/DP1

Right Leg

DV/DP2

Left Leg

DV/DP2

Right Leg

T15

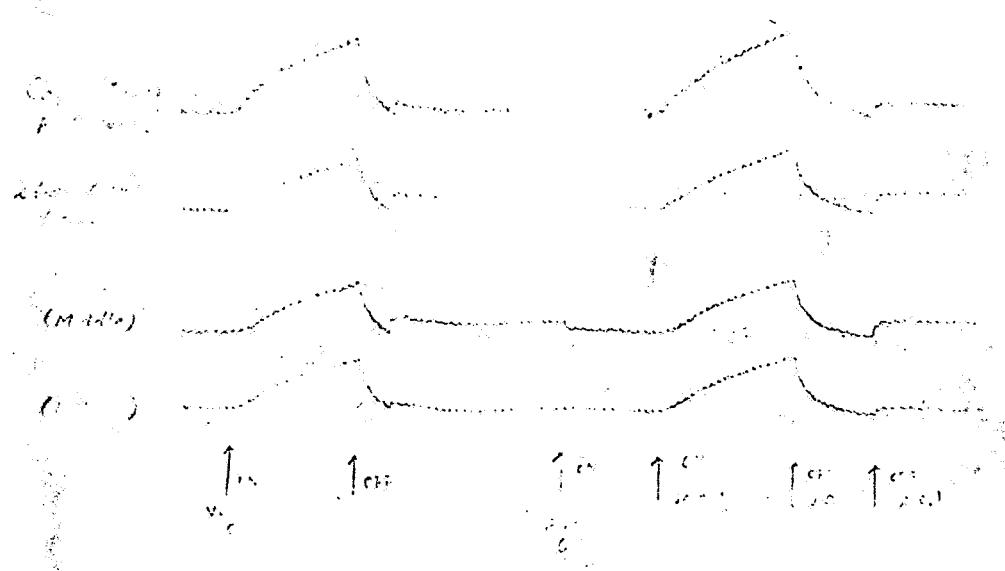
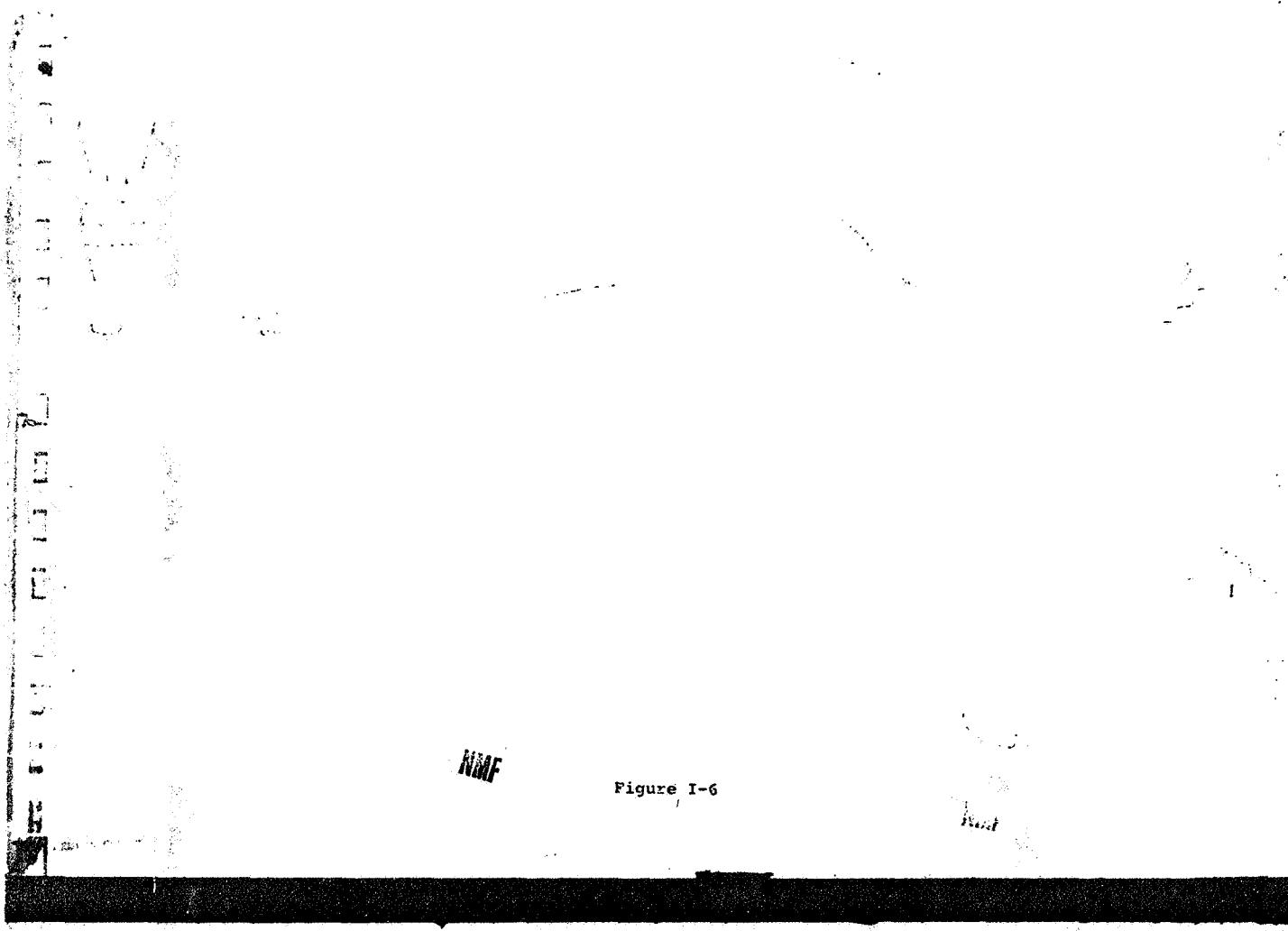
Left Leg

T15

Right Leg

NEGATIVE PRESSURE TESTSNEGATIVE PRESSURE TESTS

Measure	Condition	SET 26	SET 27	SET 28	SET 29	SET 30	Condition	Leg Volume	Measure	Condition	SET 31	SET 32	SET 33
DV/DP1	Left Leg	0.365	0.306	0.326	0.450	0.377	DV/DP1	Left Leg	0.132	0.225	0.352		
		0.22	0.32	0.21	0.18	0.19			0.39	0.05	0.27		
DV/DP1	Right Leg	-0.029	-0.020	-0.007	-0.084	-0.021	DV/DP1	Right Leg	-0.090	-0.080	-0.036		
		0.05	0.05	0.09	0.05	0.07			0.22	0.03	0.06		
DV/DP2	Left Leg	0.404	0.16	0.320	0.401	0.351	DV/DP2	Left Leg	0.329	0.305	0.406		
		0.15	0.16	0.09	0.10	0.11			0.10	0.05	0.11		
DV/DP2	Right Leg	-0.016	-0.025	-0.010	-0.064	-0.066	DV/DP2	Right Leg	0.009	-0.015	-0.069		
		0.06	0.06	0.05	0.08	0.09			0.06	0.08	0.10		
T15	Left Leg	0.691	0.272	0.284	1.159	0.454	T15	Left Leg	0.339	0.210	0.585		
		0.76	0.61	0.55	0.68	0.85			0.93	0.49	0.79		
T15	Right Leg	-0.230	-0.502	-0.602	-0.586	-0.599	T15	Right Leg	-0.579	-0.390	-0.622		
		0.44	0.12	0.39	0.31	0.58			0.34	0.01	0.50		



NMF

Figure I-8

NMF

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

NMF

Figure I-9

NMF

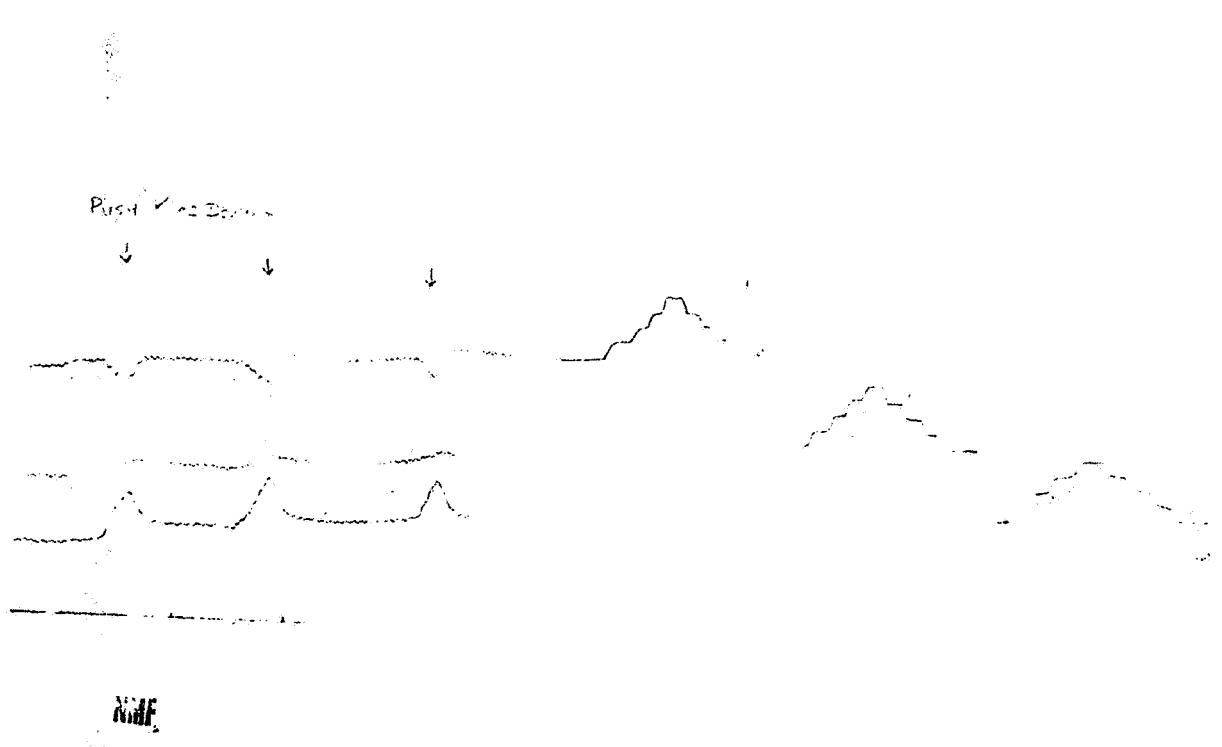


Figure I-10

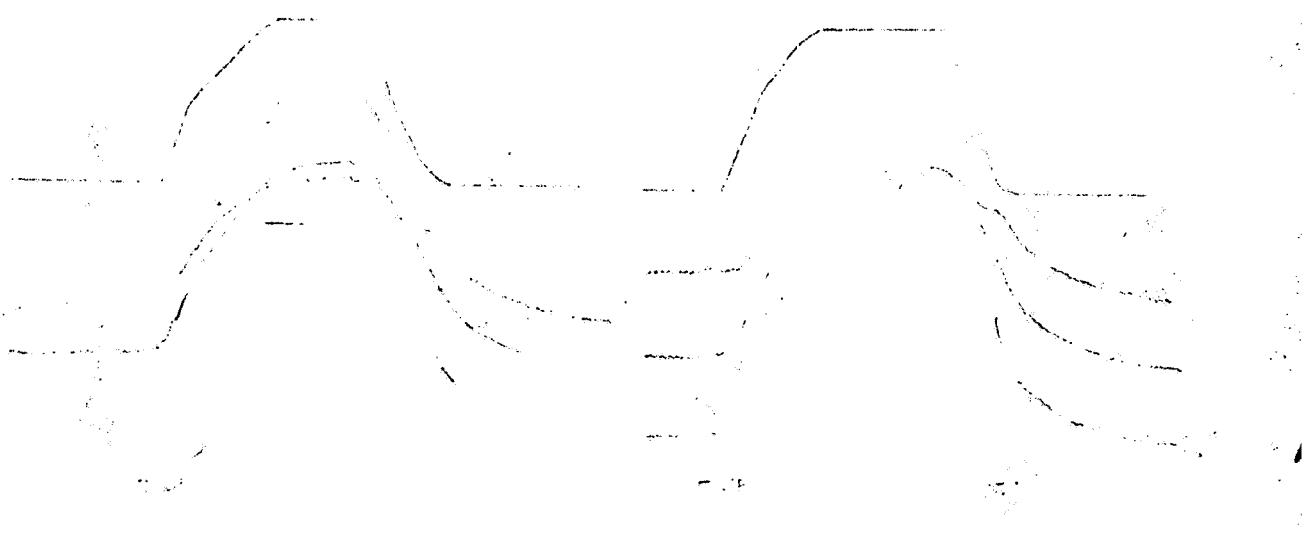


Figure I-11

A.O.

T.O.

A.O.

NMF

Figure I-12

NMF

(sp. 1)

NMF

Figure I-13

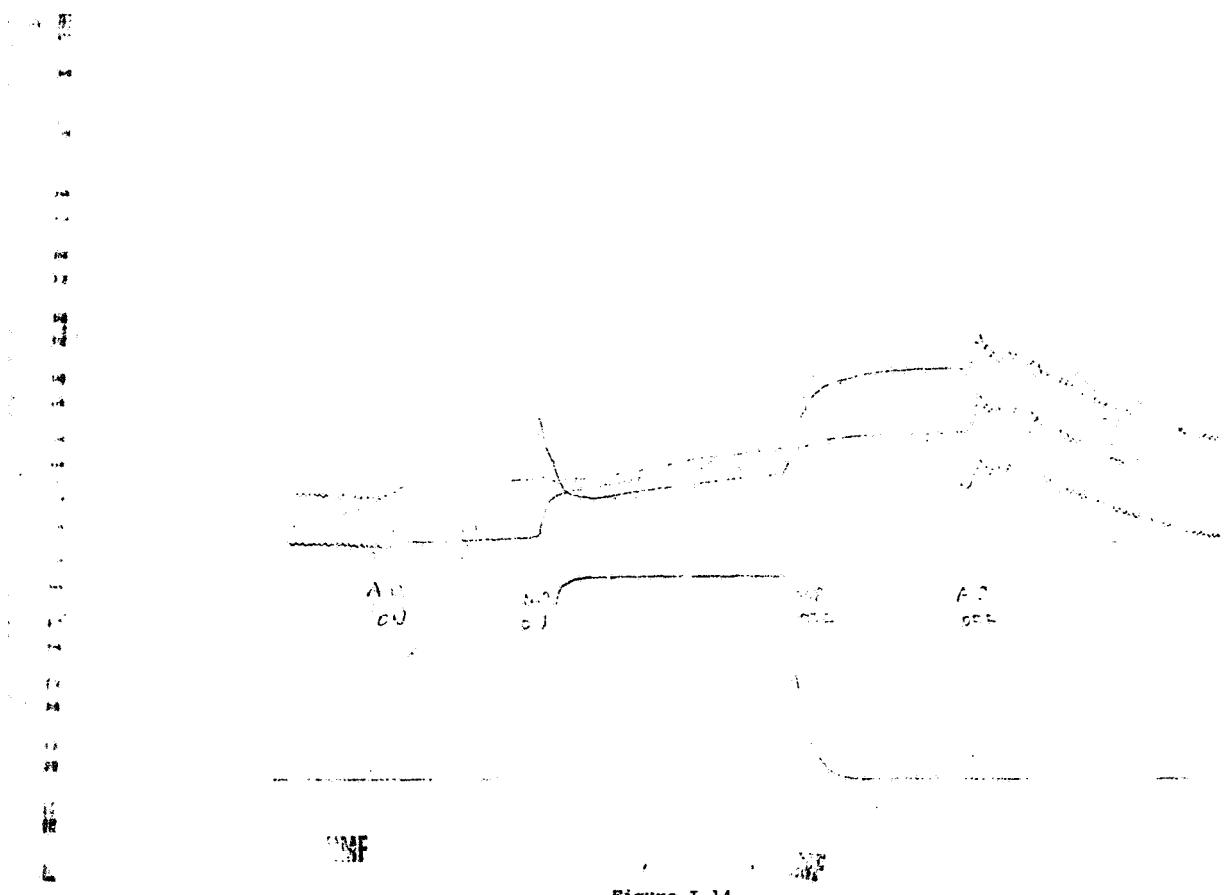


Figure I-14

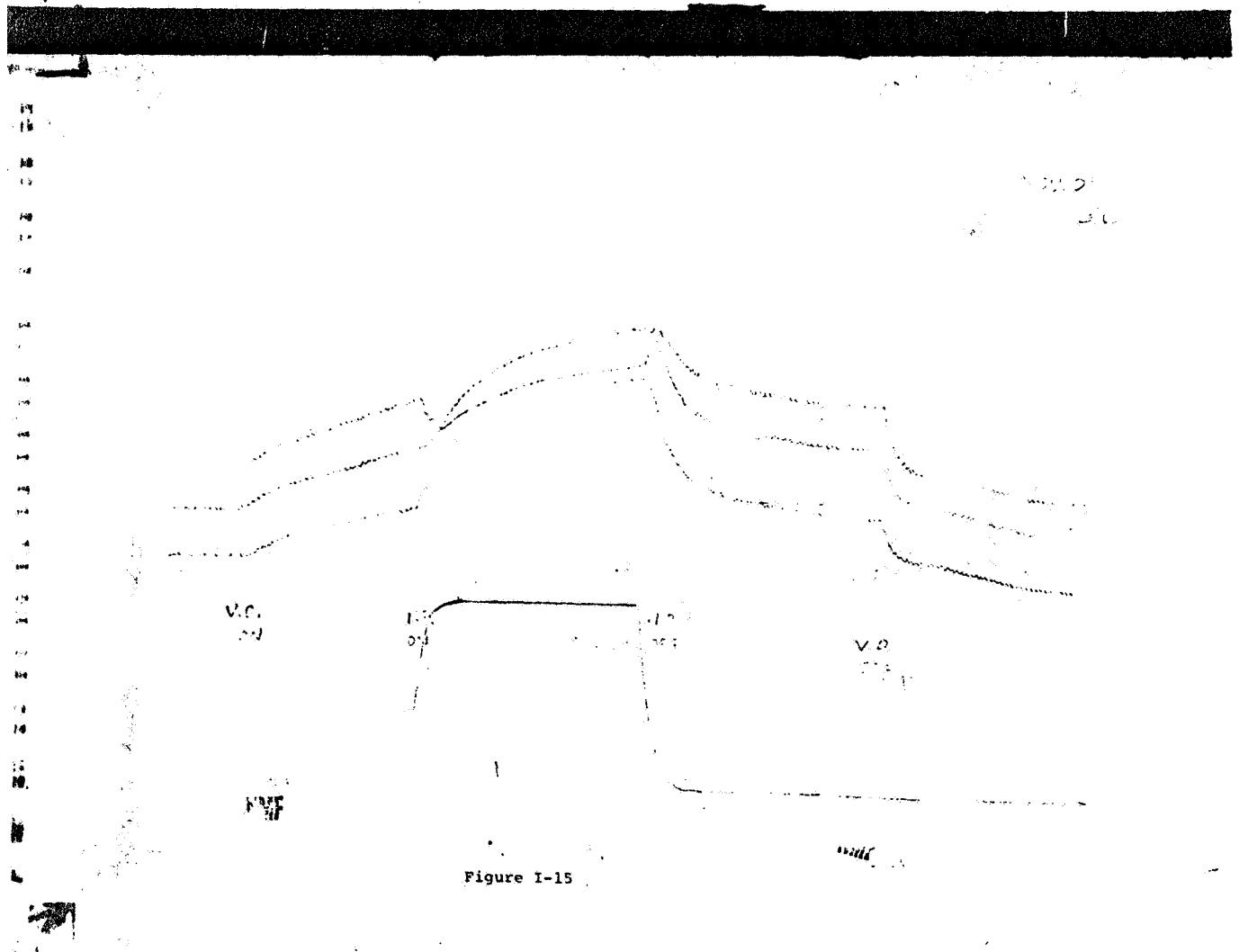


Figure I-15

Table III-6a

Table III-6b

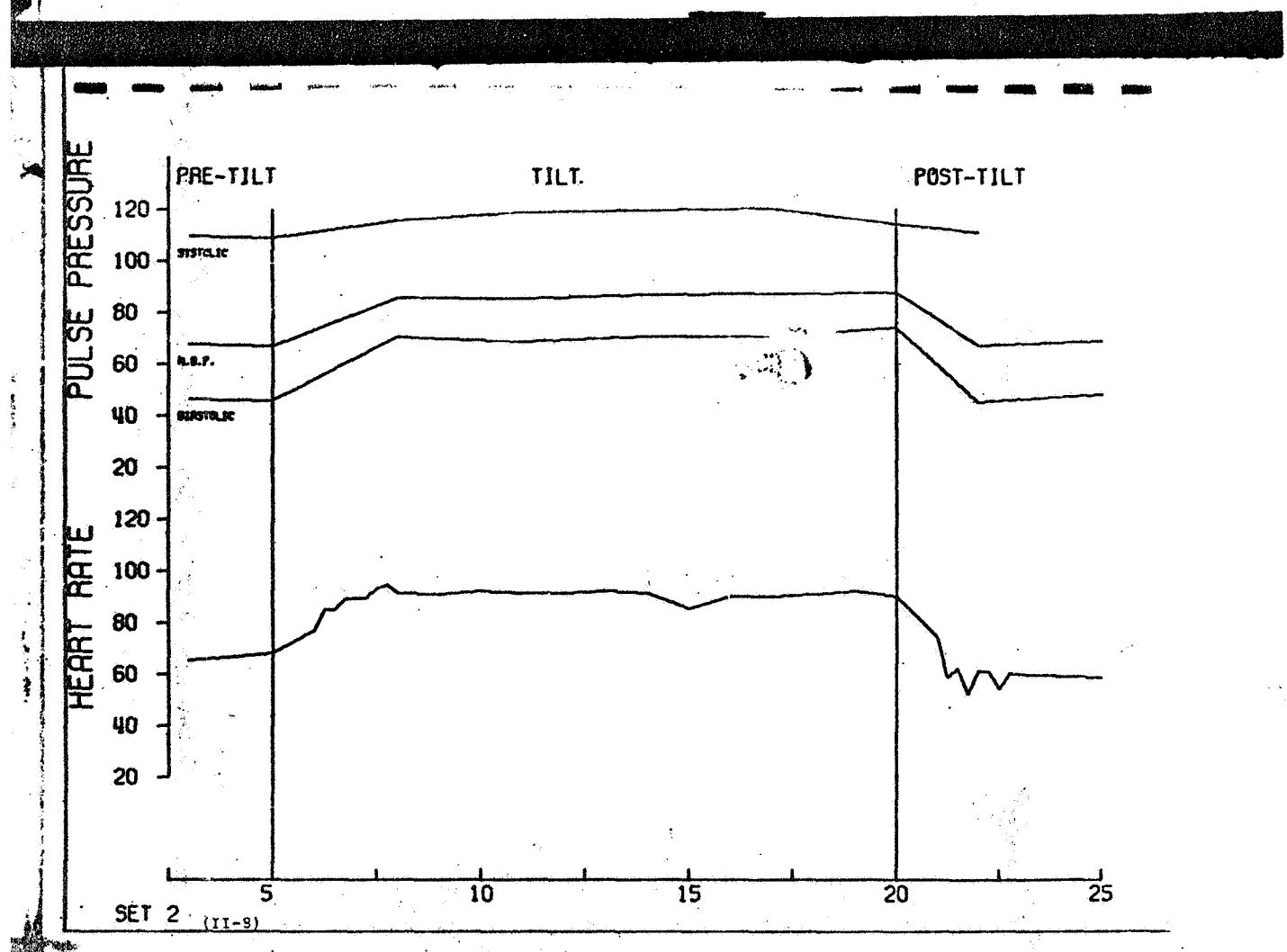
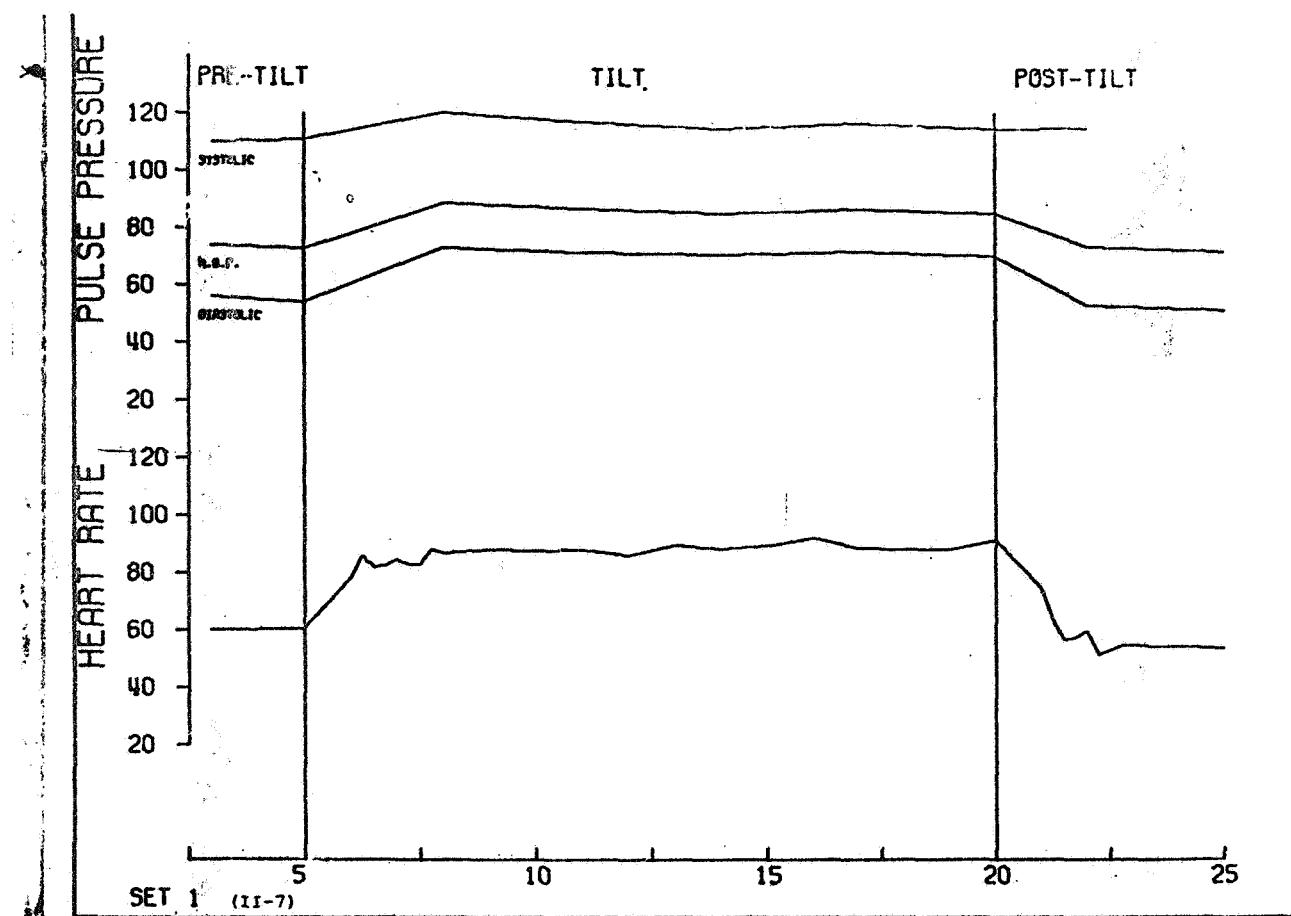
Comparative Values

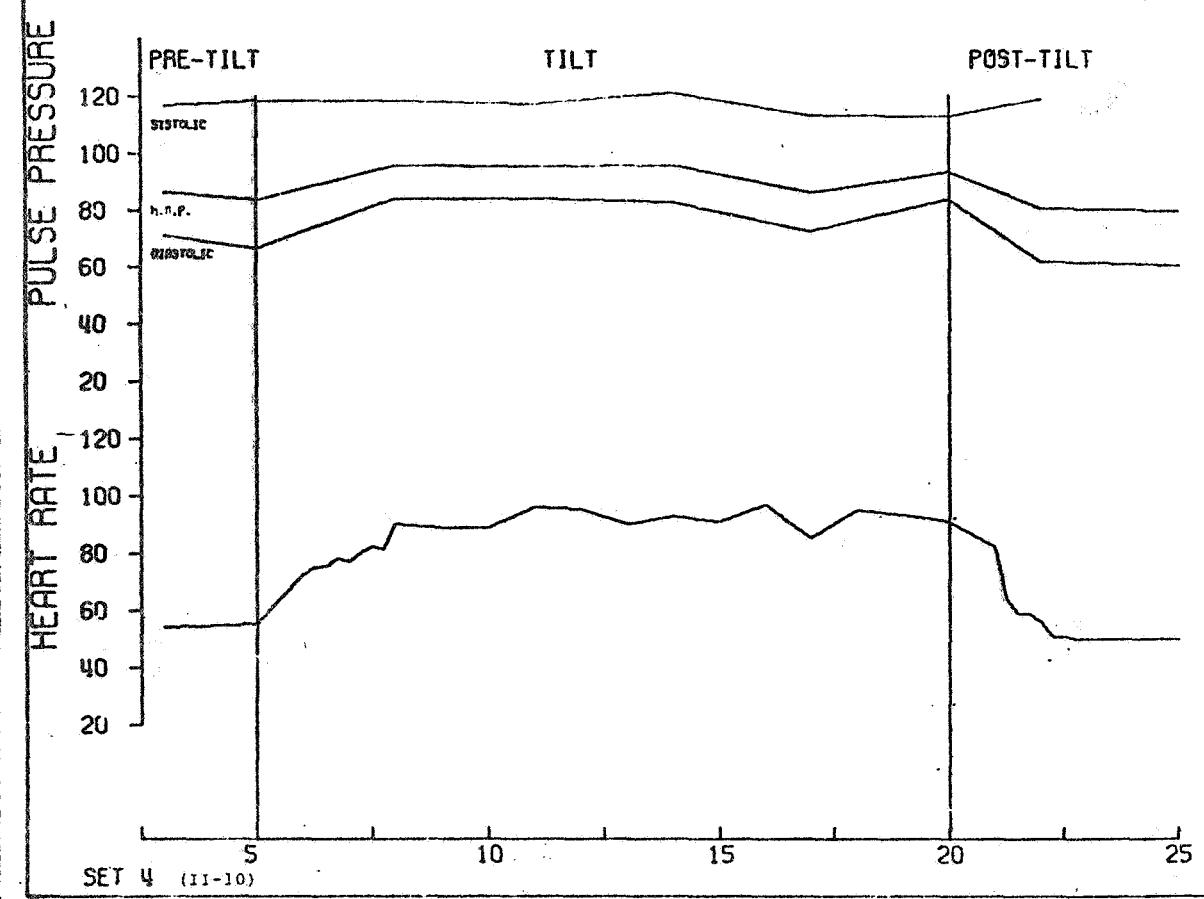
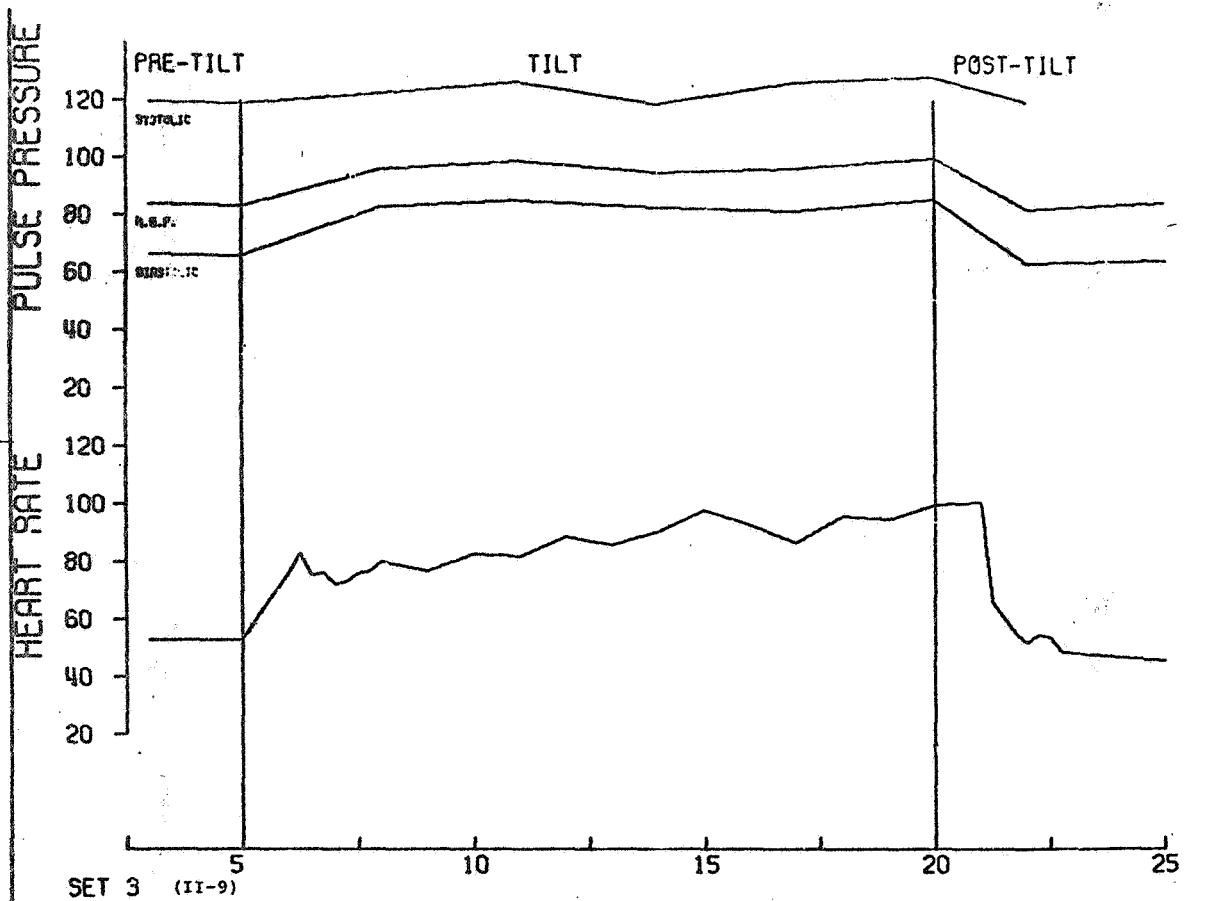
	Hour 0	2.5	12.0	24.0	48.0
mean resting HR	2.875	-2.625	16.125	2.339	5.125
mean tilt HR	3.11	3.58	4.11	4.15	+4.87
mean tilt L.D.	5.048	8.067	17.771	7.444	3.298
mean tilt RR	5.20	6.54	3.87	6.17	6.06
ax Tilt HR	13.009	12.590	18.500	9.857	3.000
ax slope 1st min of tilt	5.83	7.34	4.27	6.82	6.48
ax slope 1st min Post-tilt	5.250	5.625	1.075	1.446	1.125
ax slope 1st min Post-tilt	4.26	5.62	4.12	3.10	3.50
ax tilt pulse press A	6.197	5.812	7.037	-8.758	+0.108
ax tilt pulse press A	7.64	6.17	3.95	-0.30	3.44
mean tilt pulse pressure	-3.233	-6.156	+0.268	+2.379	+5.725
mean tilt pulse pressure	3.59	-4.56	3.76	-4.61	5.19
air tilt pulse pressure	-4.313	-10.563	-1.313	-3.545	+3.812
air tilt pulse pressure	4.10	5.04	3.40	6.13	5.96
ax L.G. Volume	-0.099	-0.225	-0.260	-0.112	+0.023
ax L.G. Volume	0.336	0.237	0.237	0.292	0.269

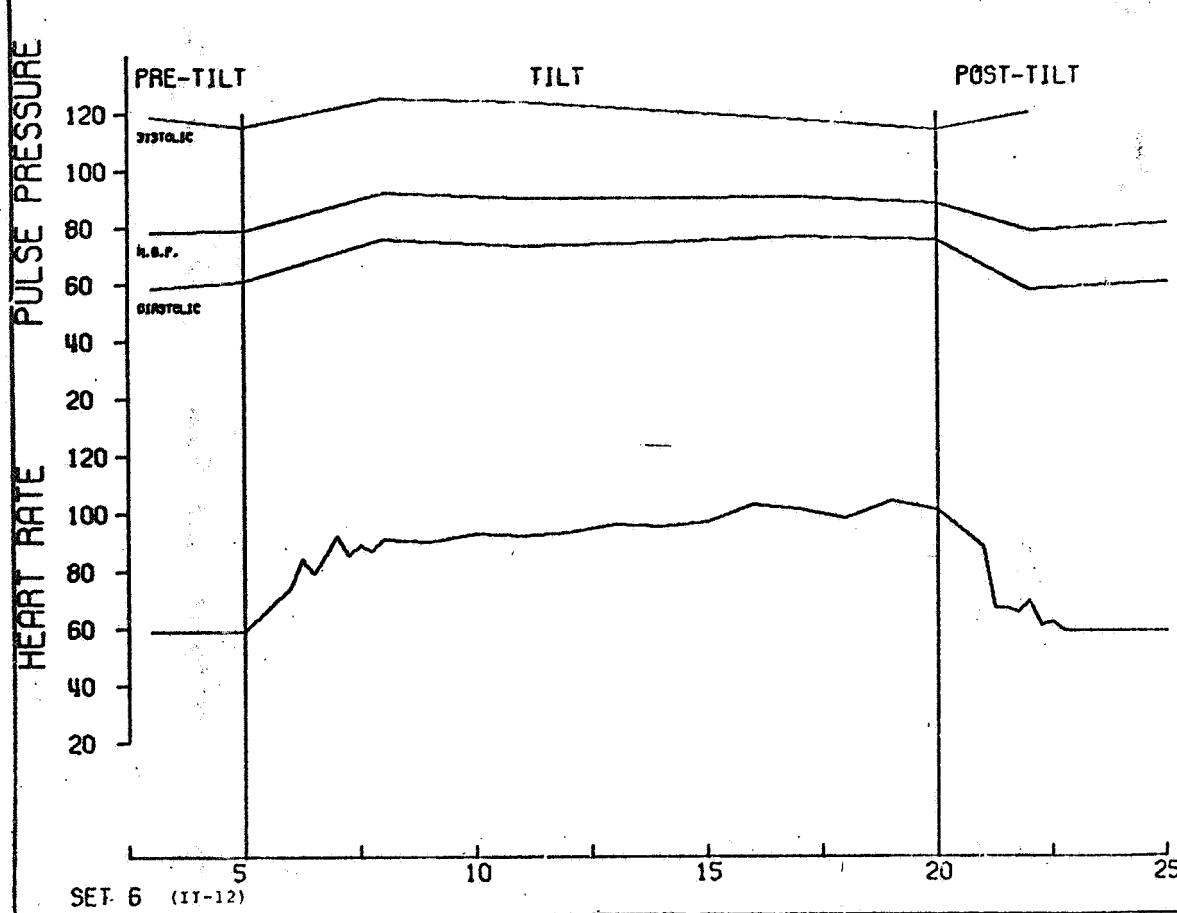
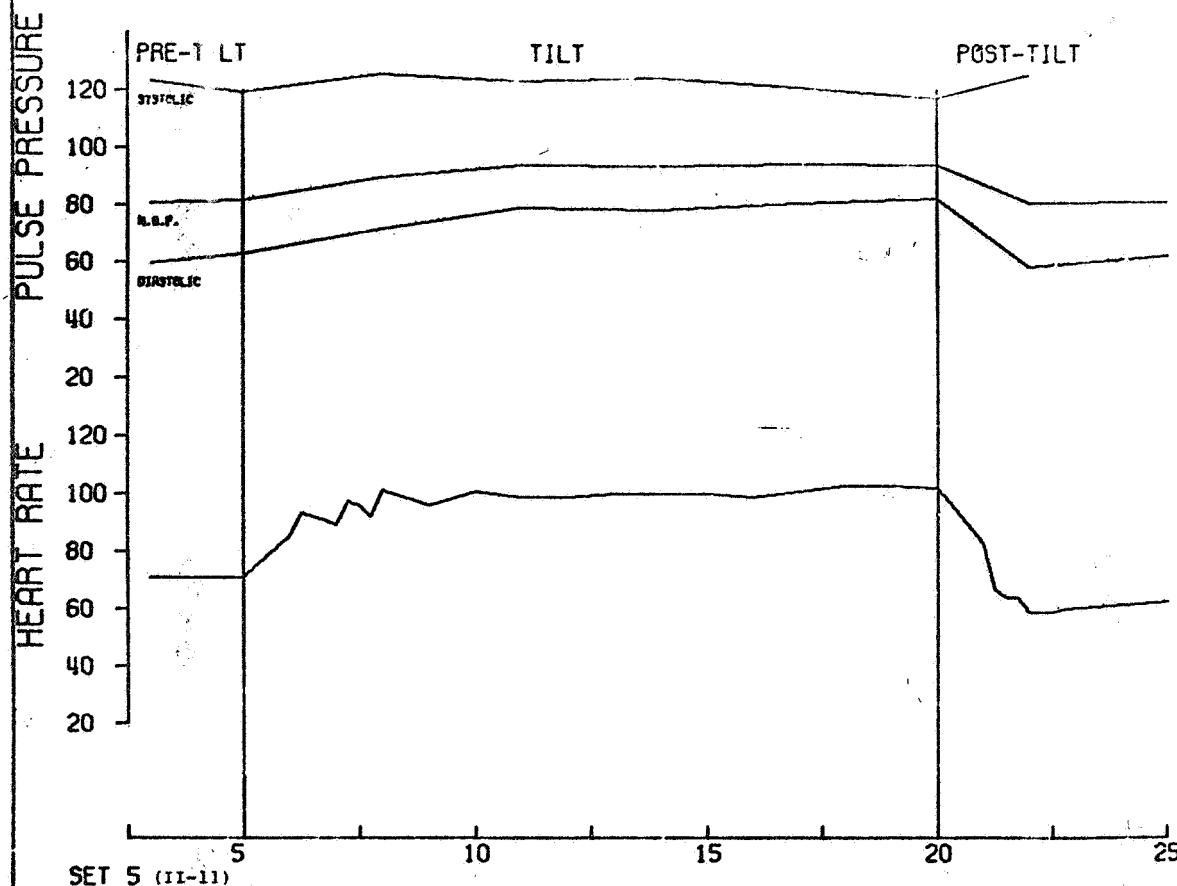
Integrator: Score

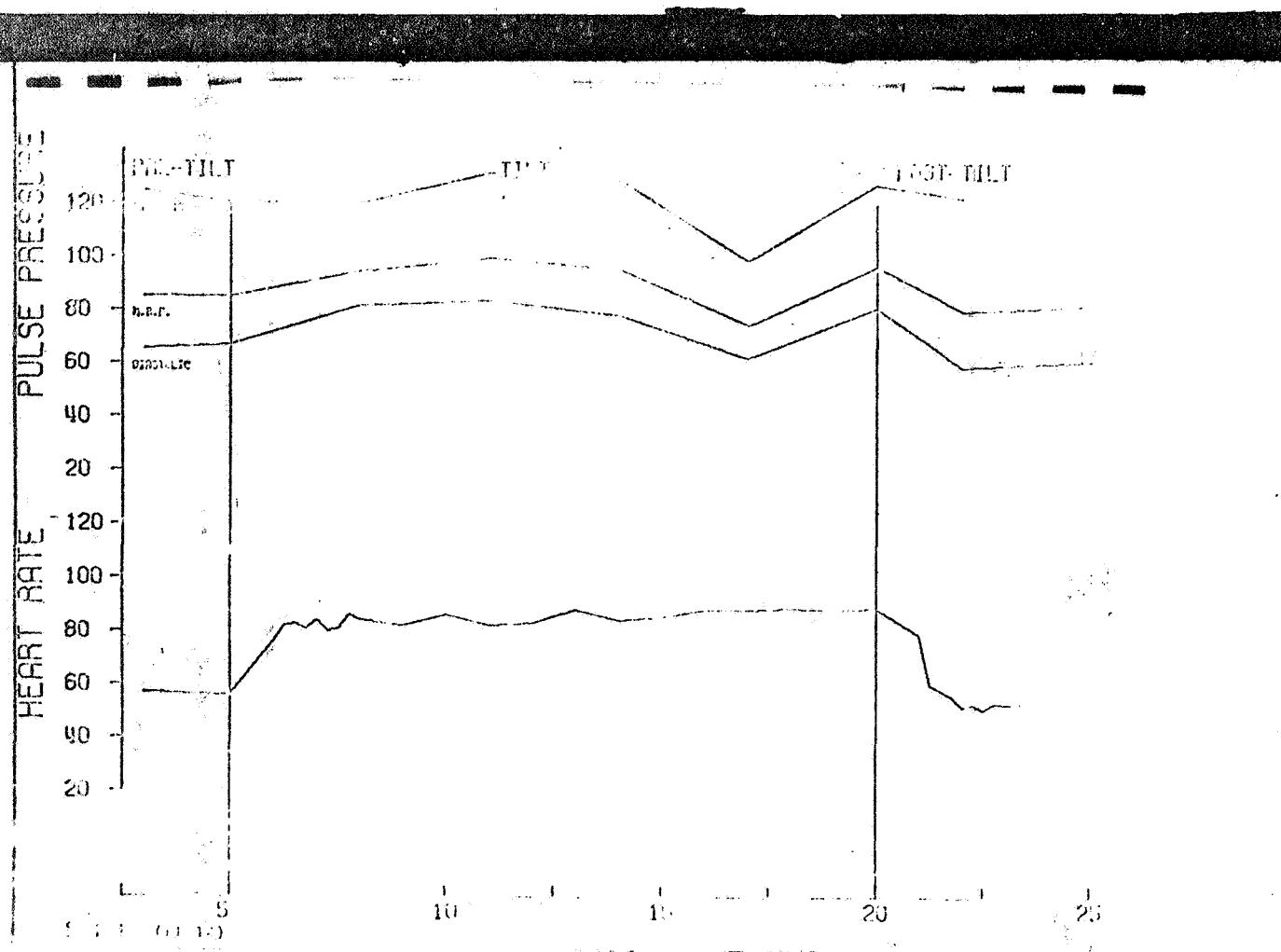
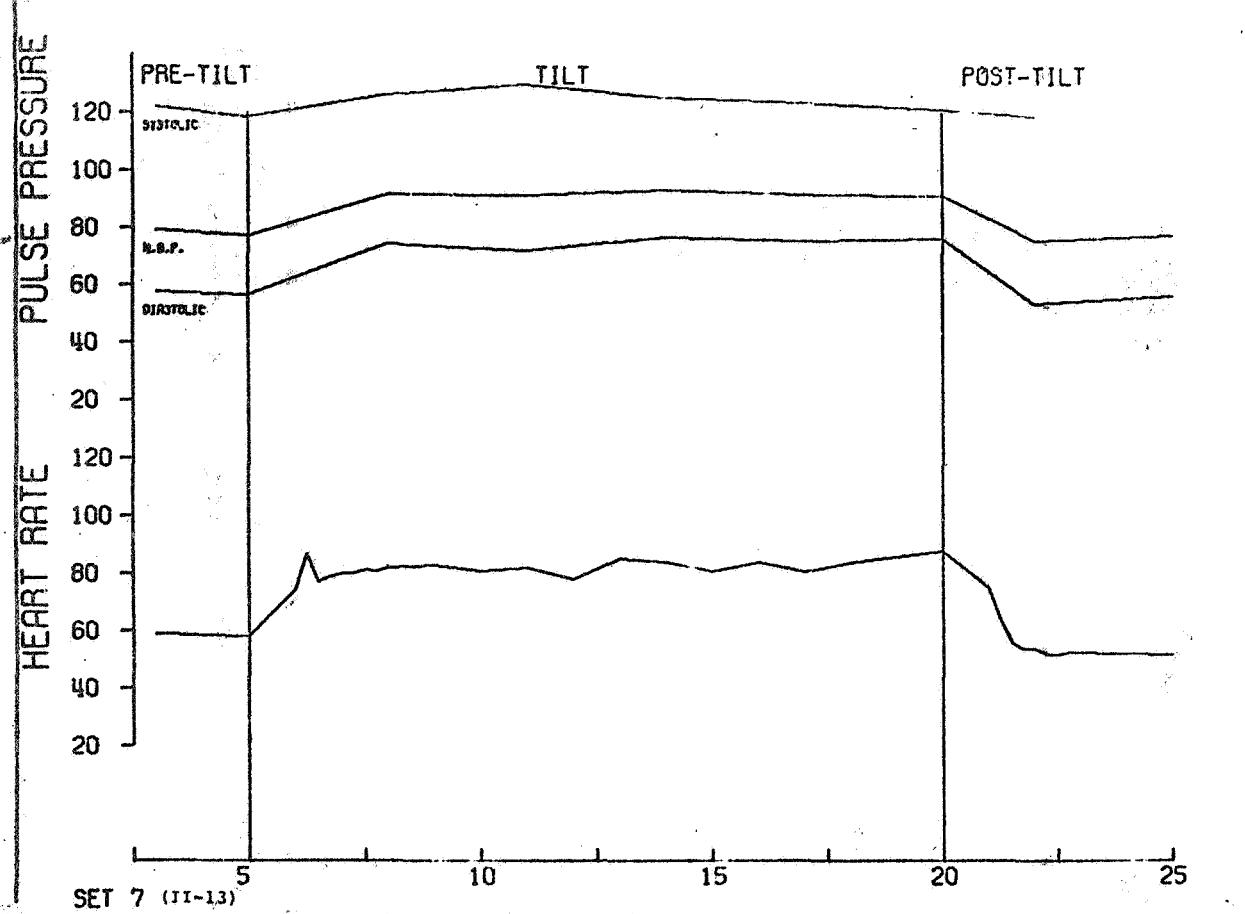
	Hour 0	2.5	12.0	24.0	48.0
mean resting HR		-0.924	-0.733	3.923	0.564
mean tilt RR		0.951	1.233	4.510	1.206
ax Tilt HR		2.230	1.793	4.333	1.445
ax slope 1st min of tilt		1.232	4.273	0.455	0.467
ax slope 1st min Post-tilt		0.910	-0.811	-1.544	-2.037
ax tilt pulse press A		0.901	1.709	-2.072	-0.516
ax tilt pulse press A		1.052	-2.086	0.386	0.576
ax Leg Volume		-0.293	-0.813	-1.181	-0.418
Integrator Score		-4.342	5.670	10.405	1.239

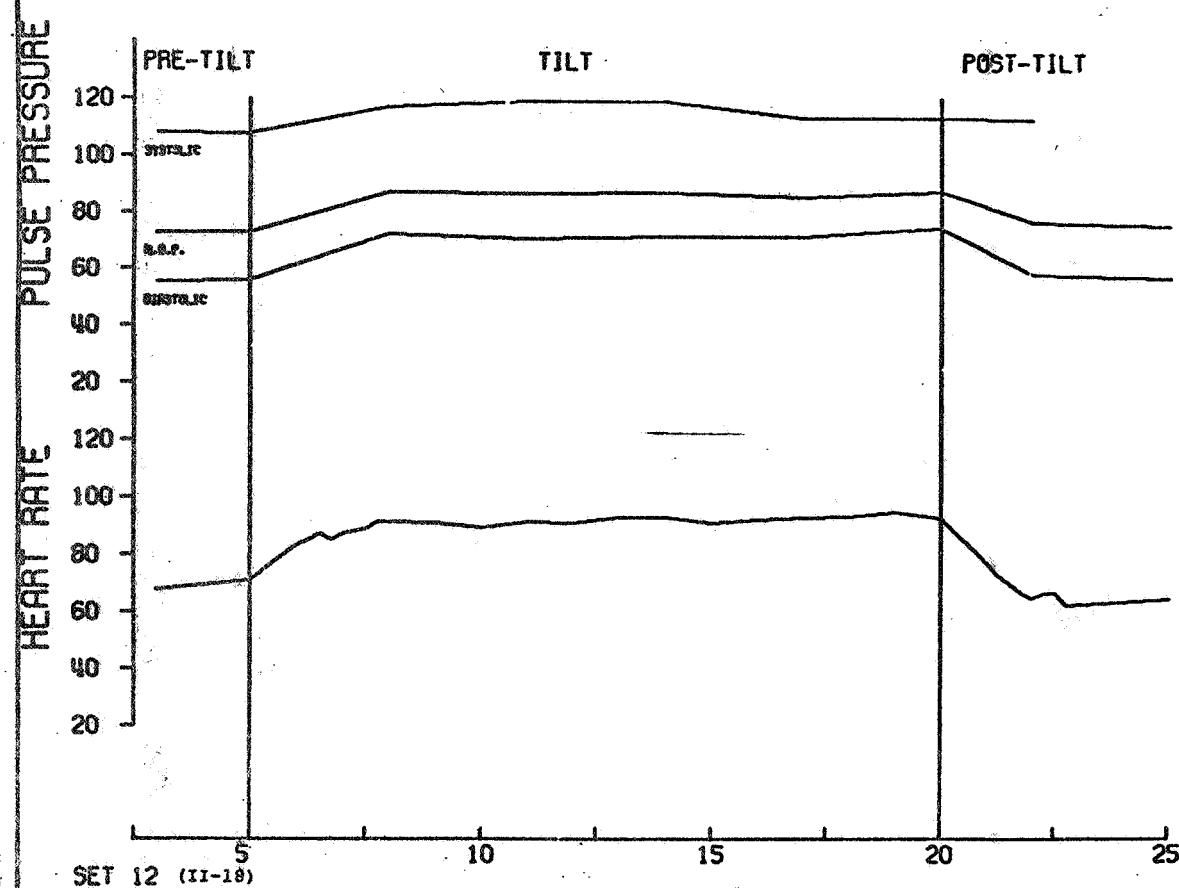
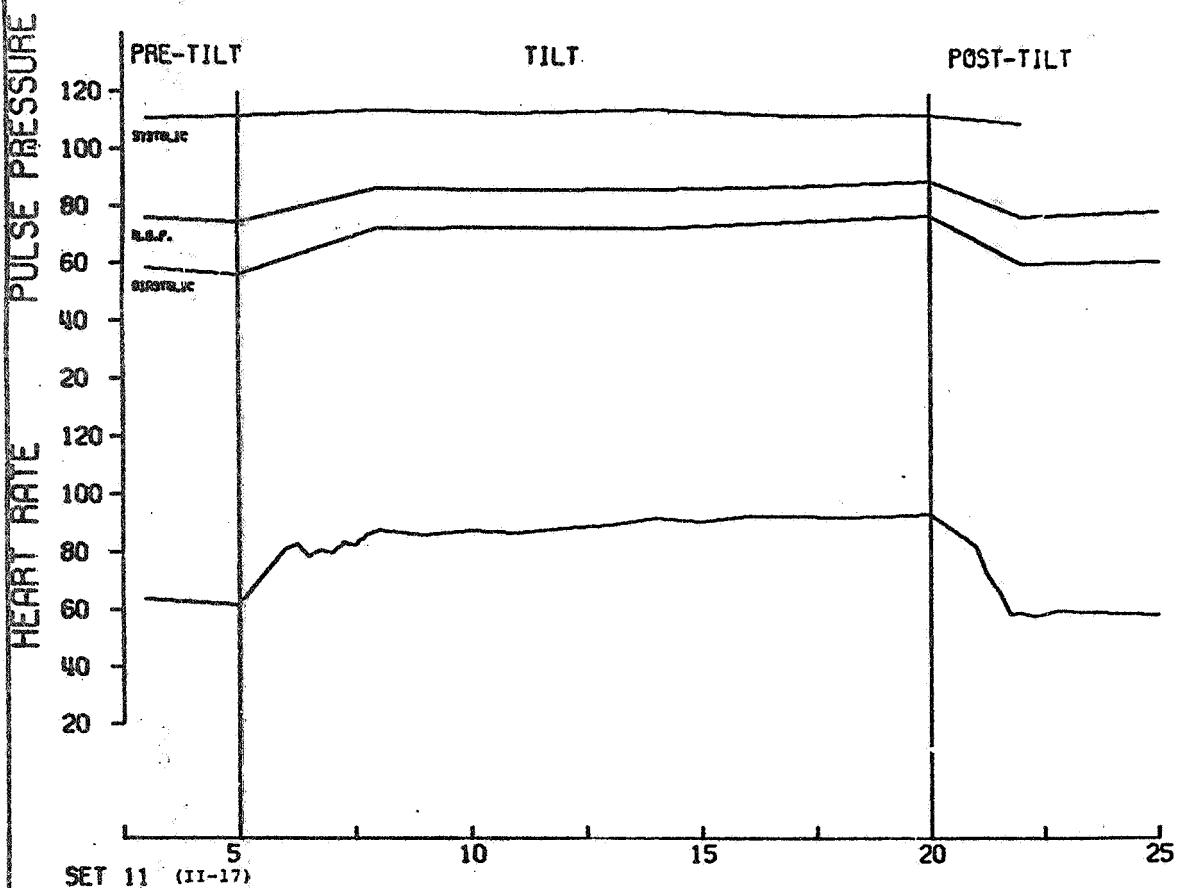
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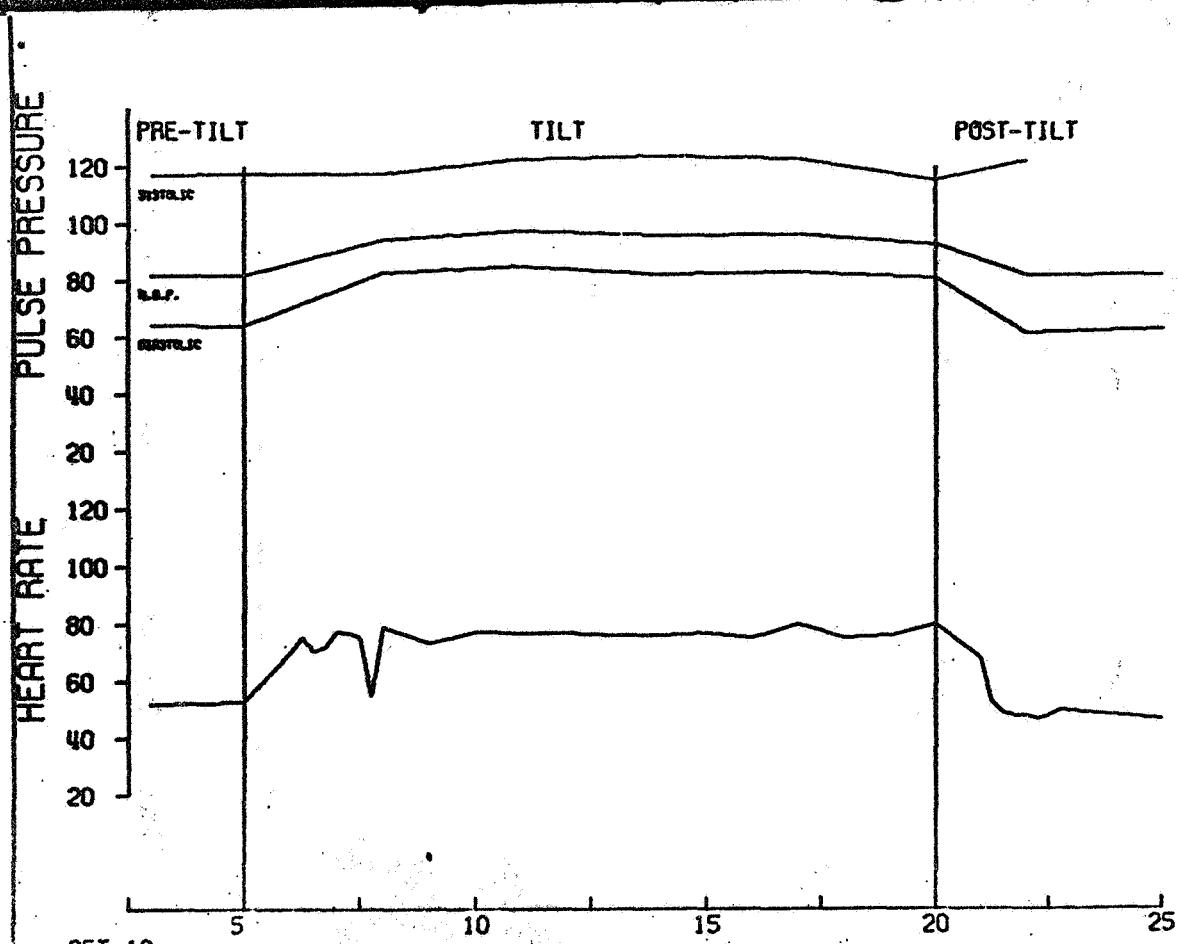
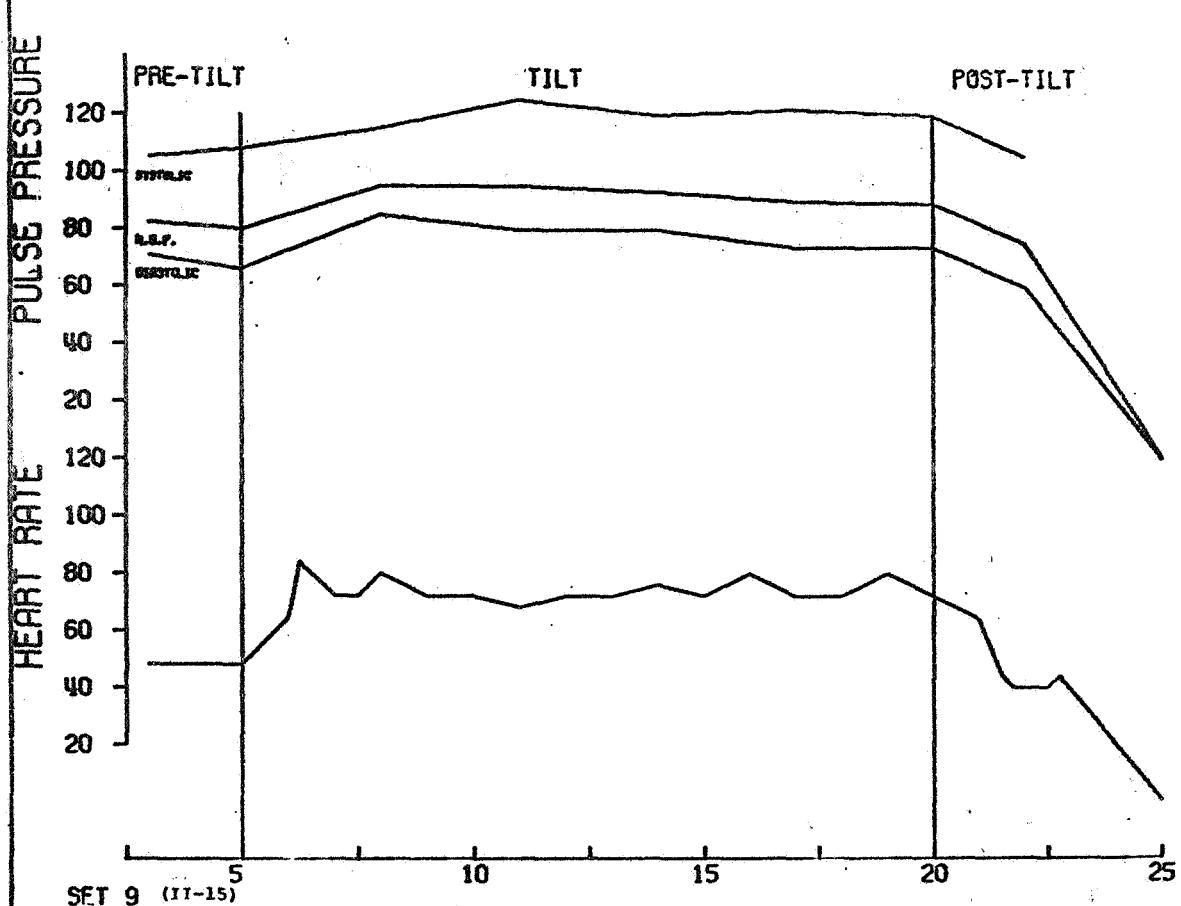


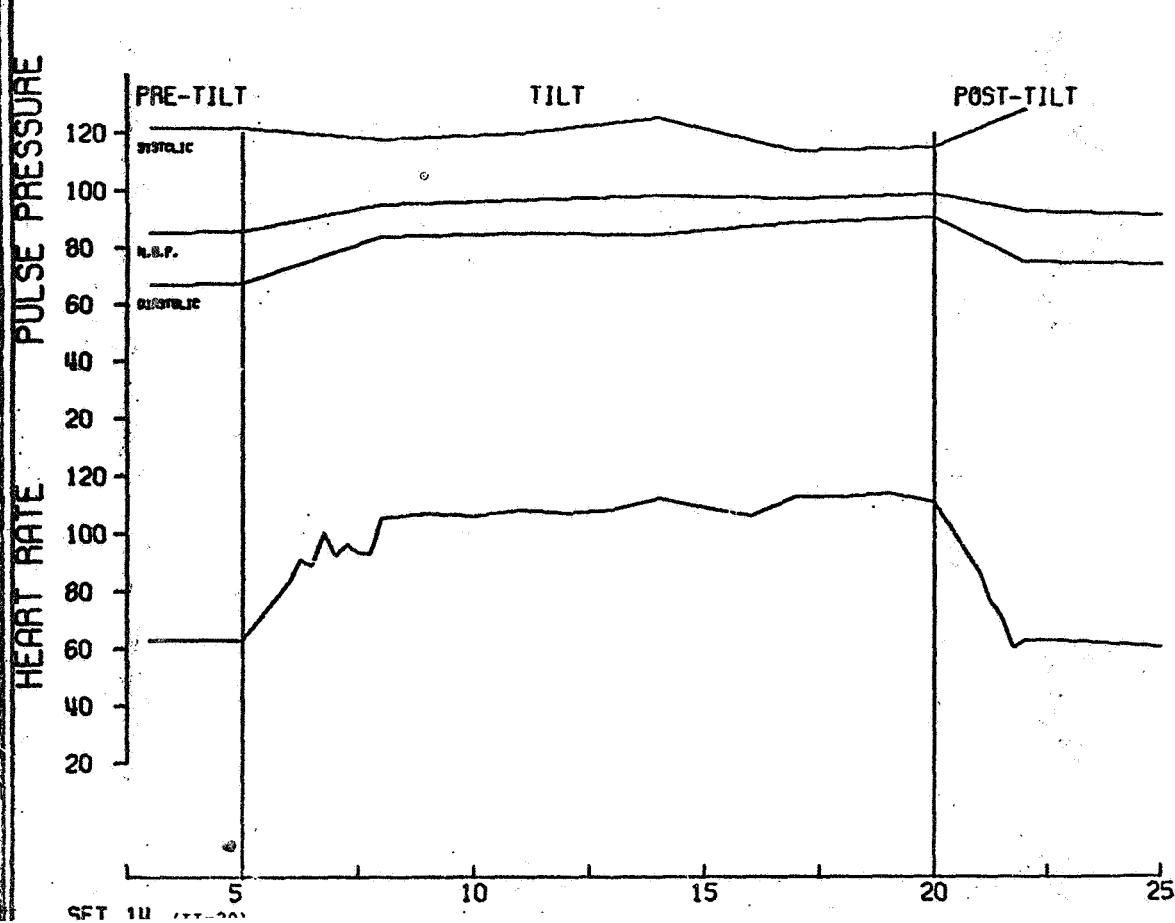
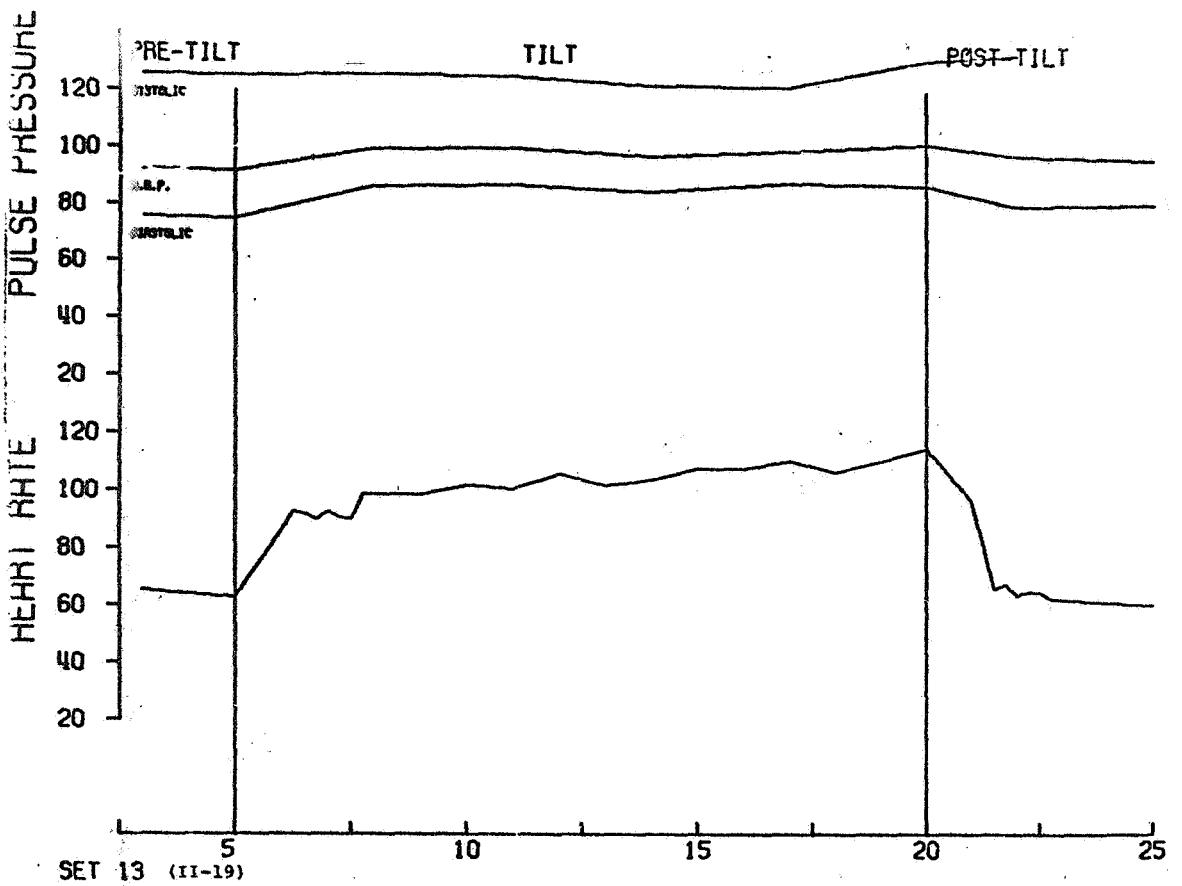


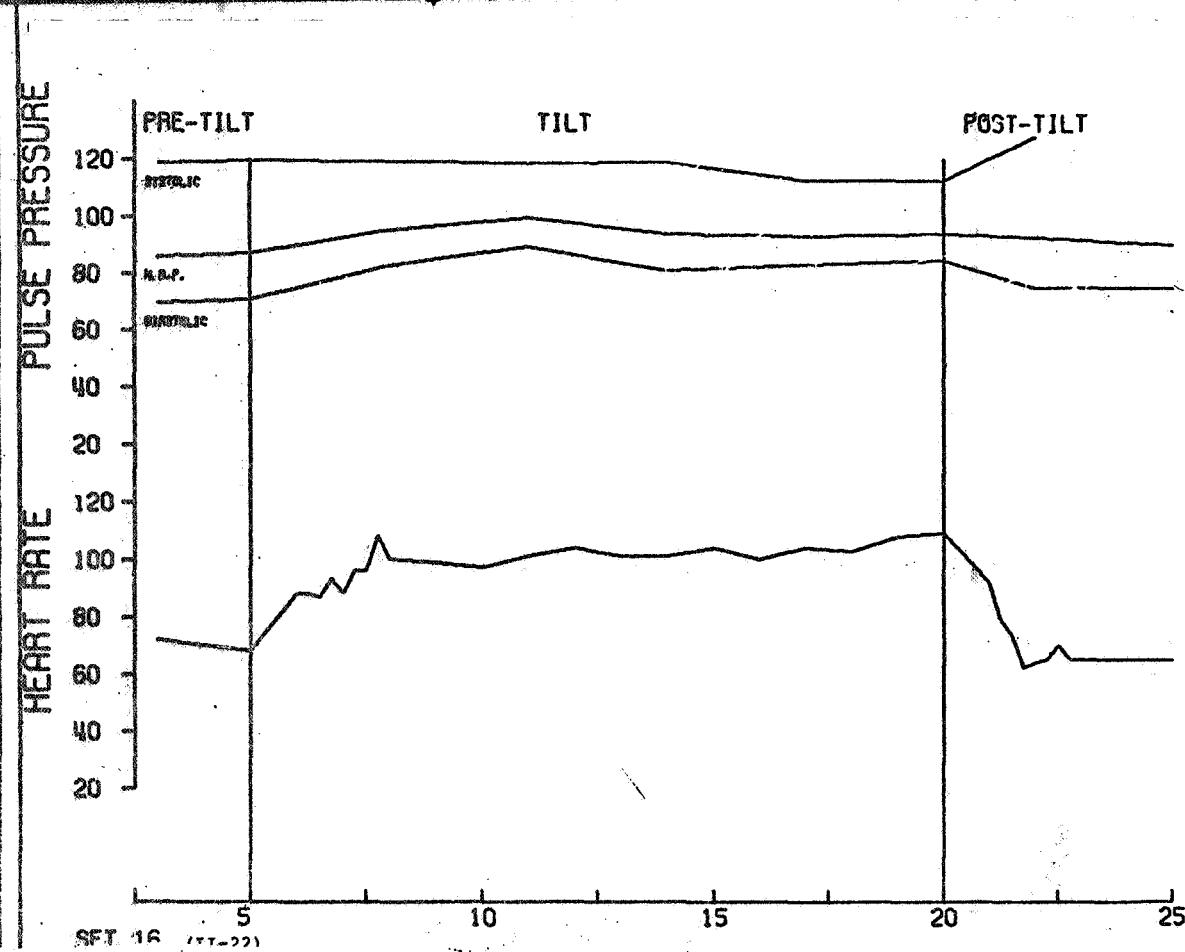
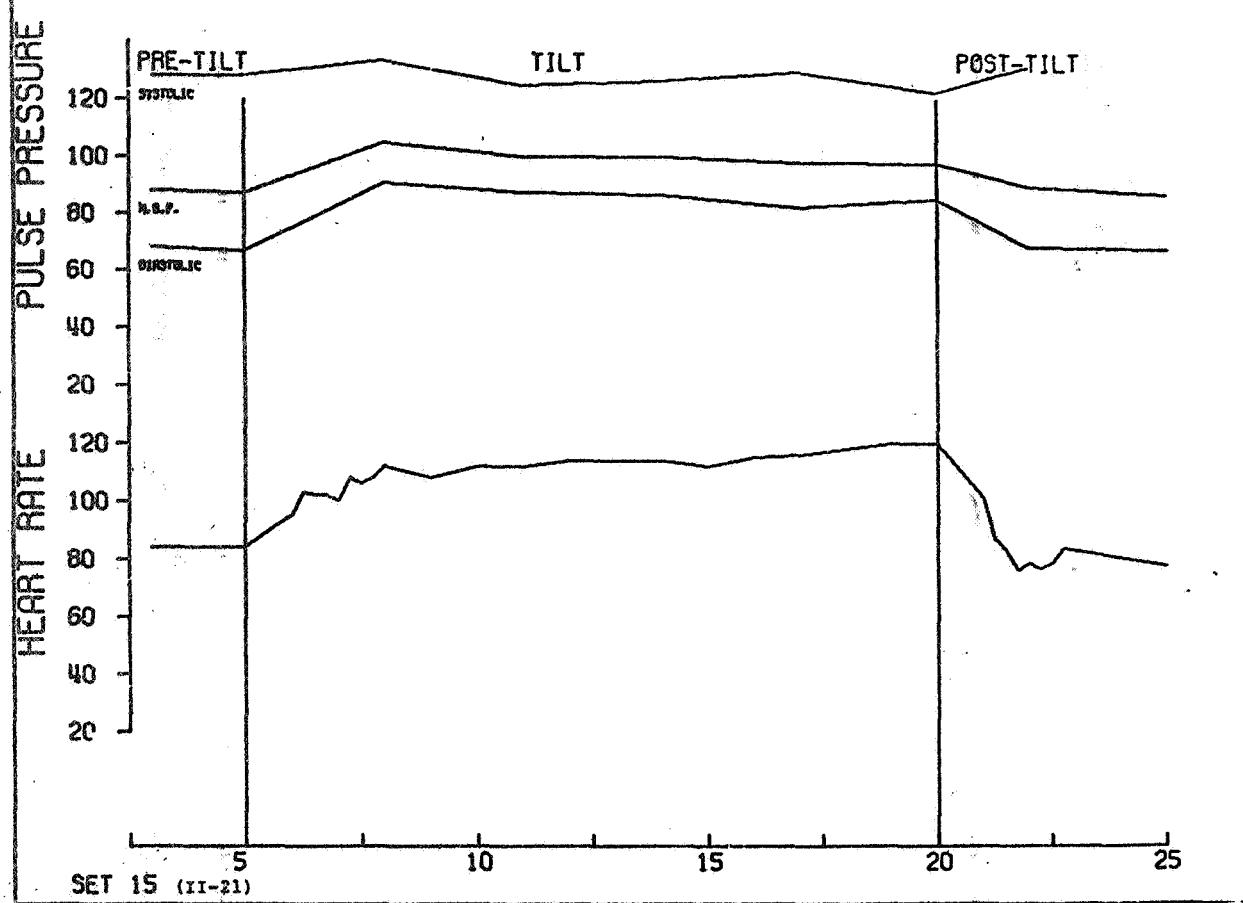


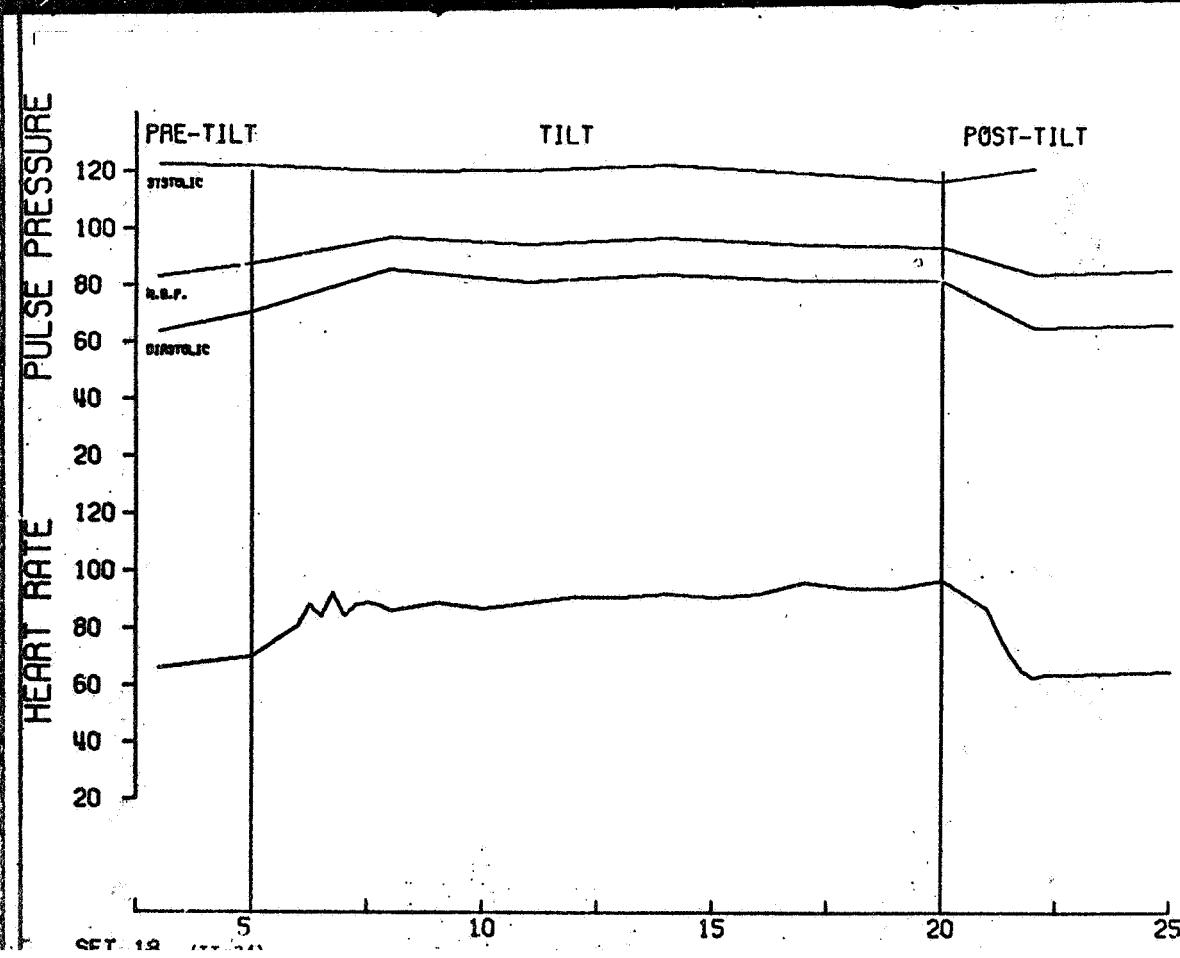
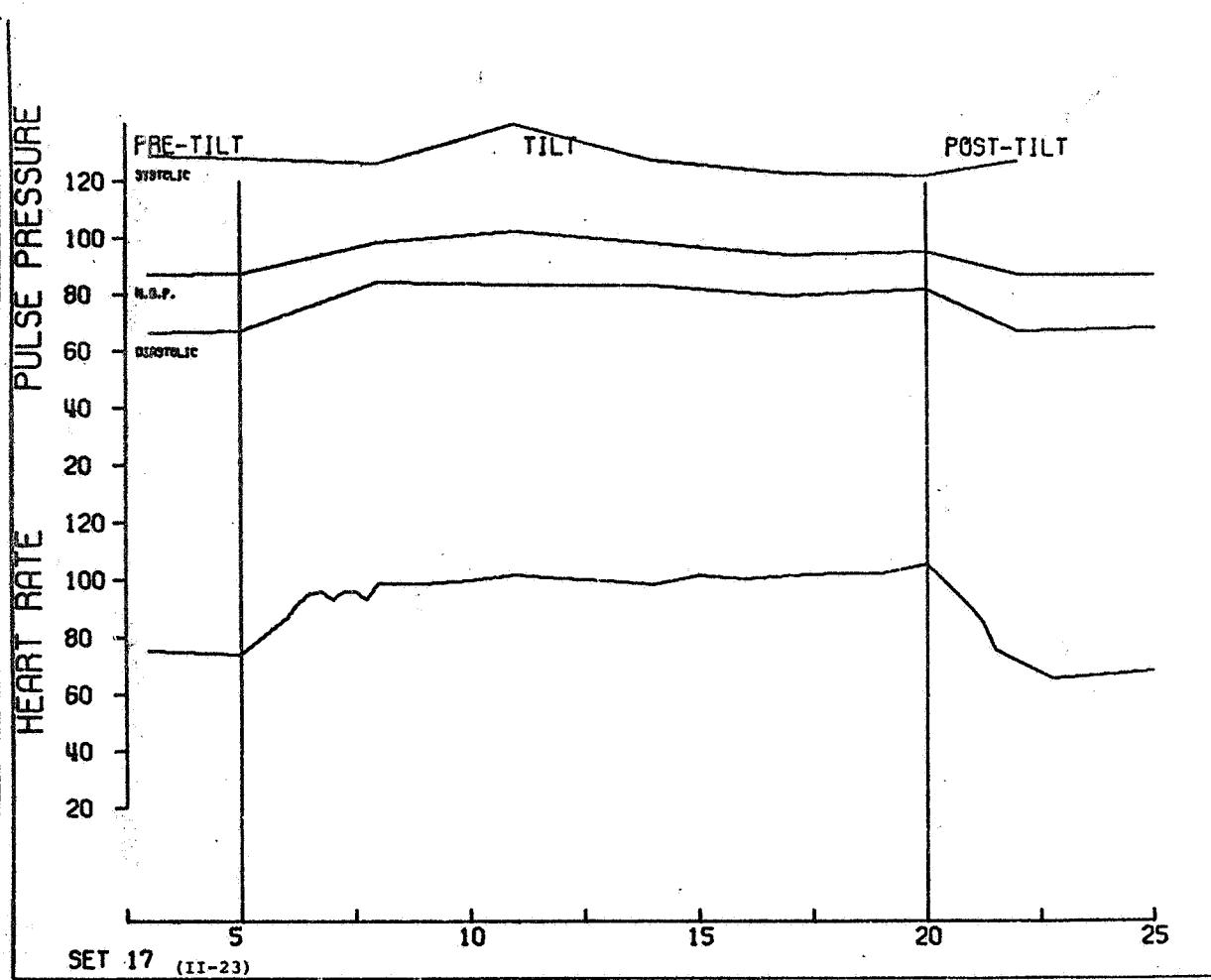


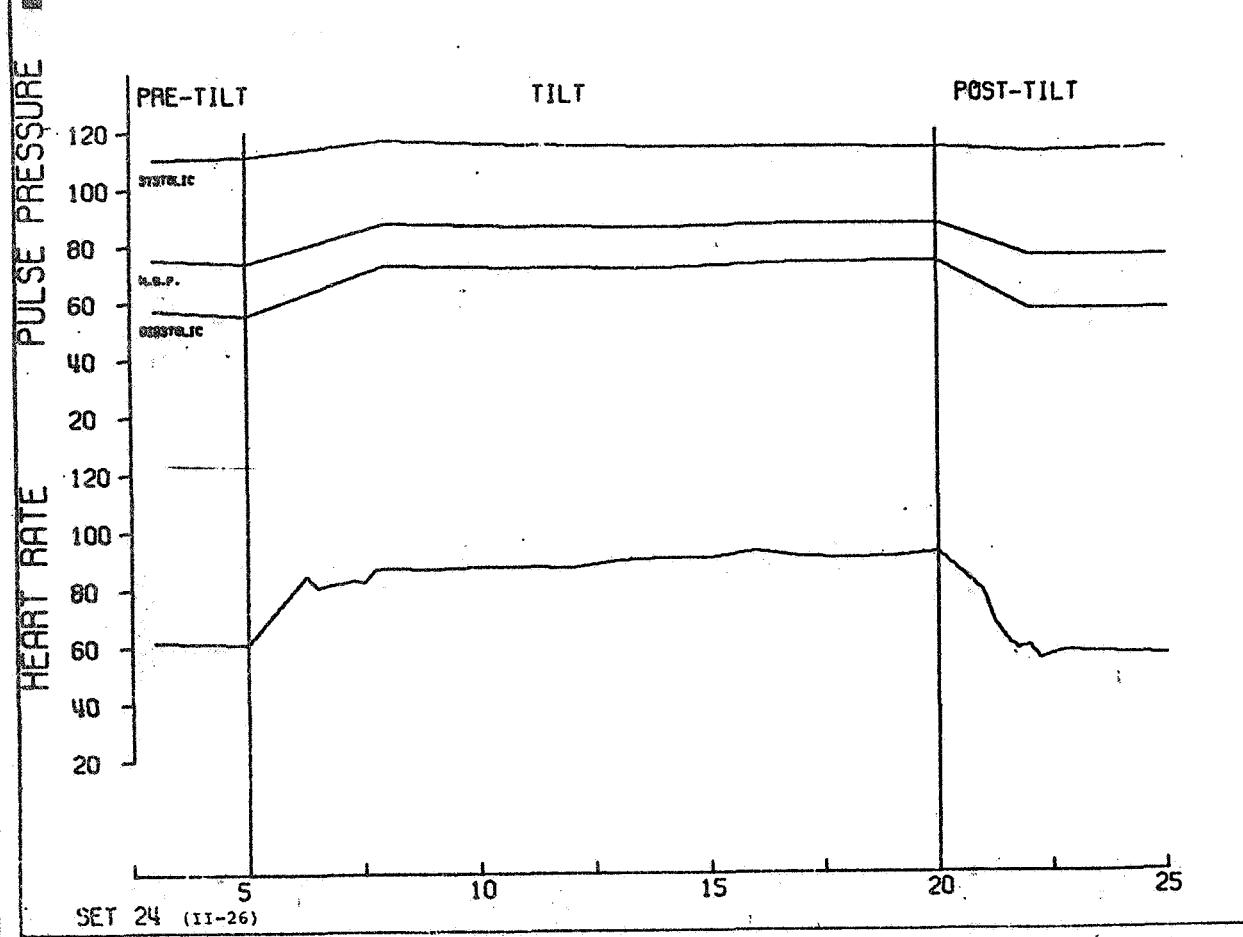
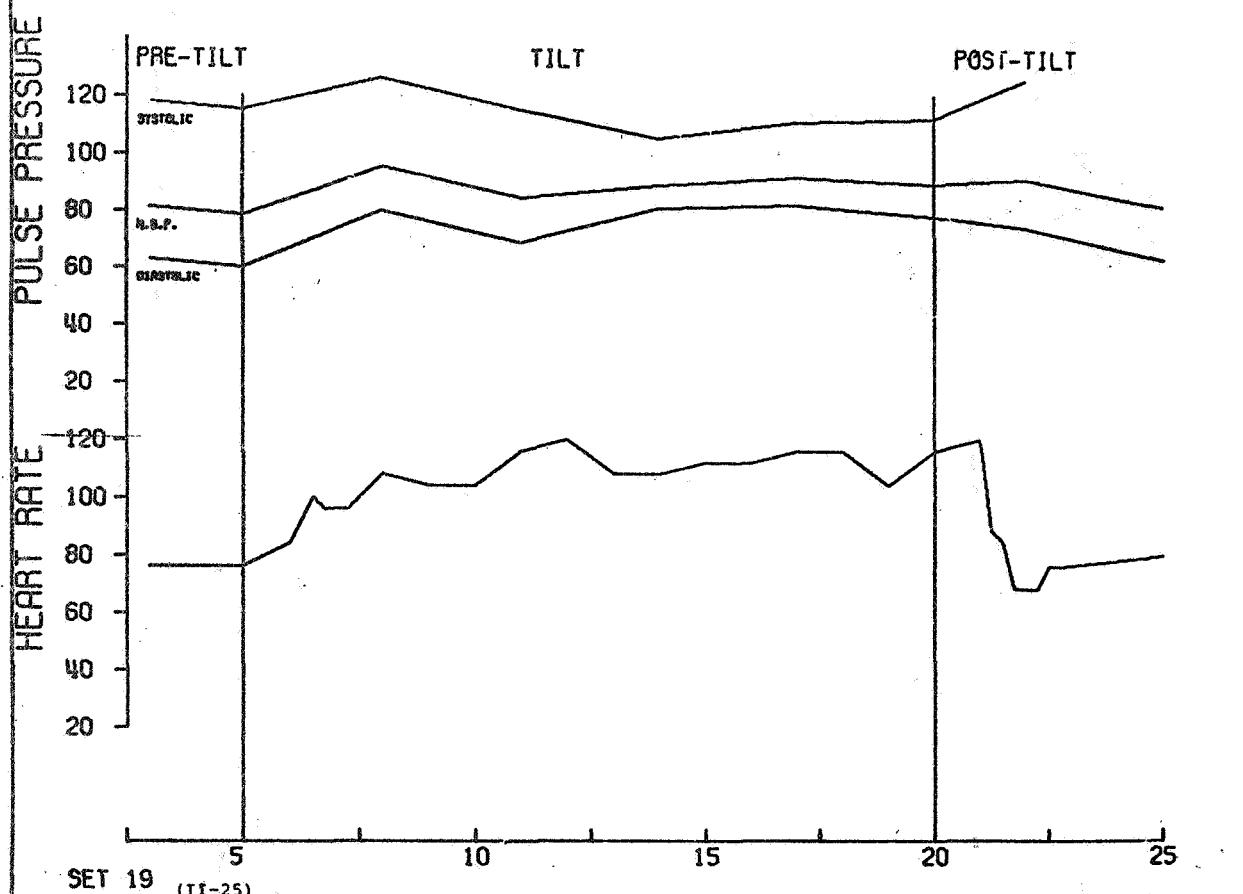


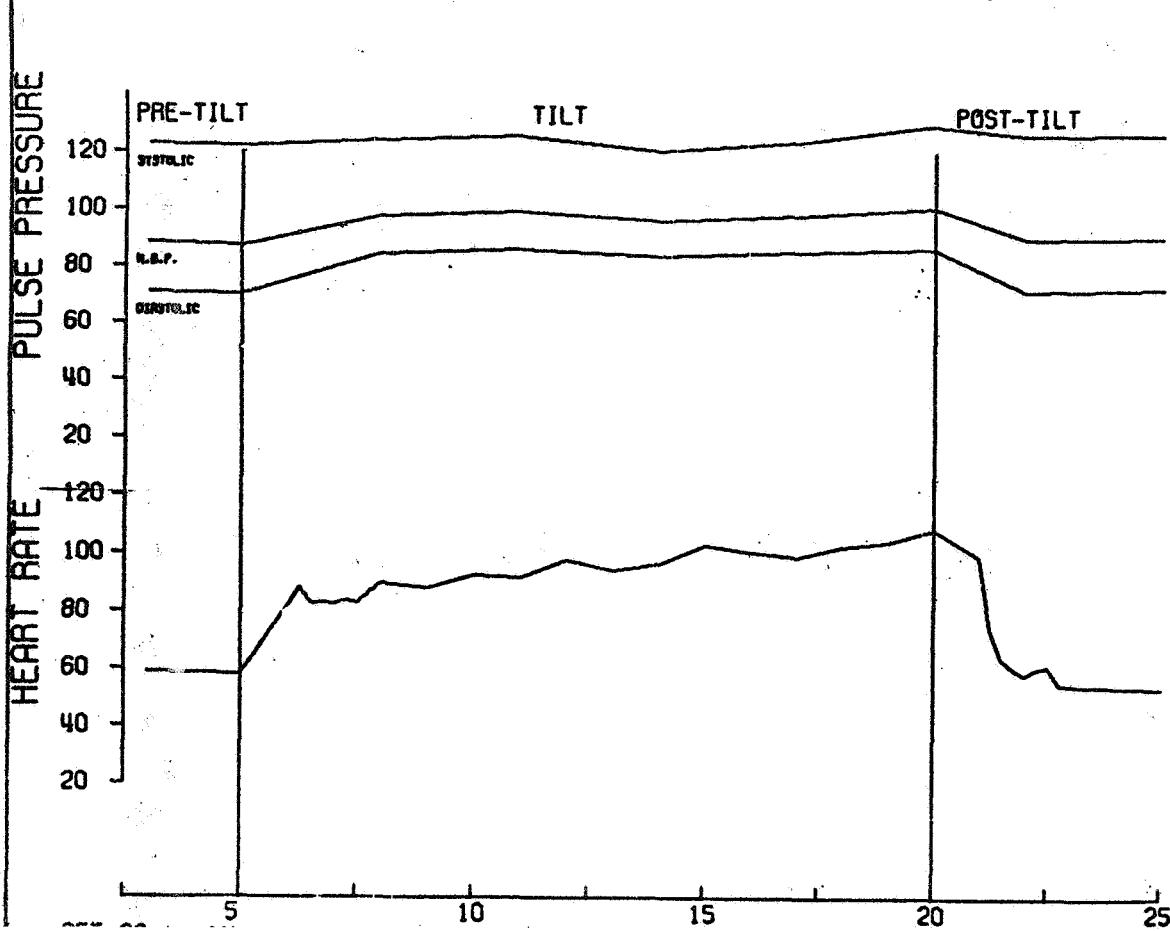
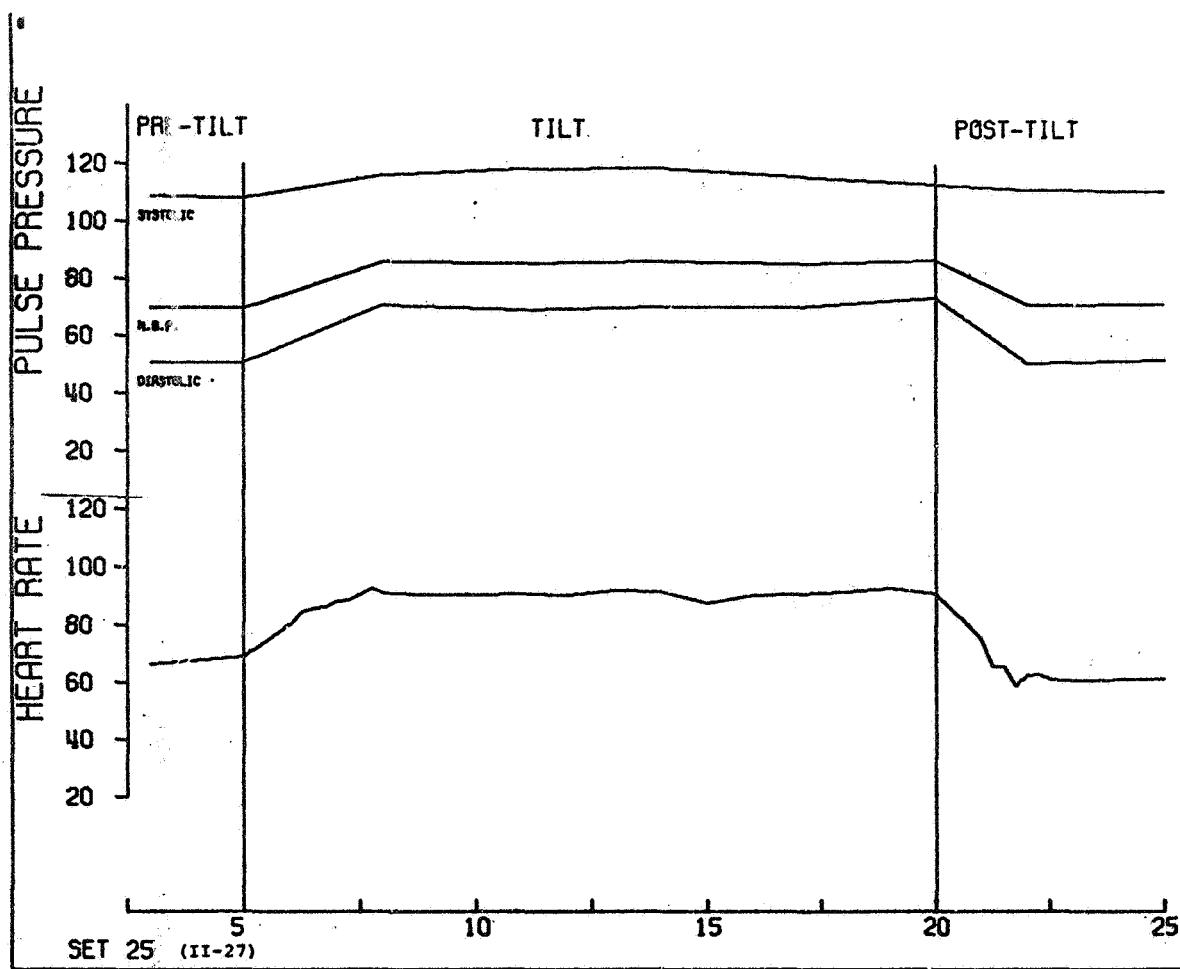


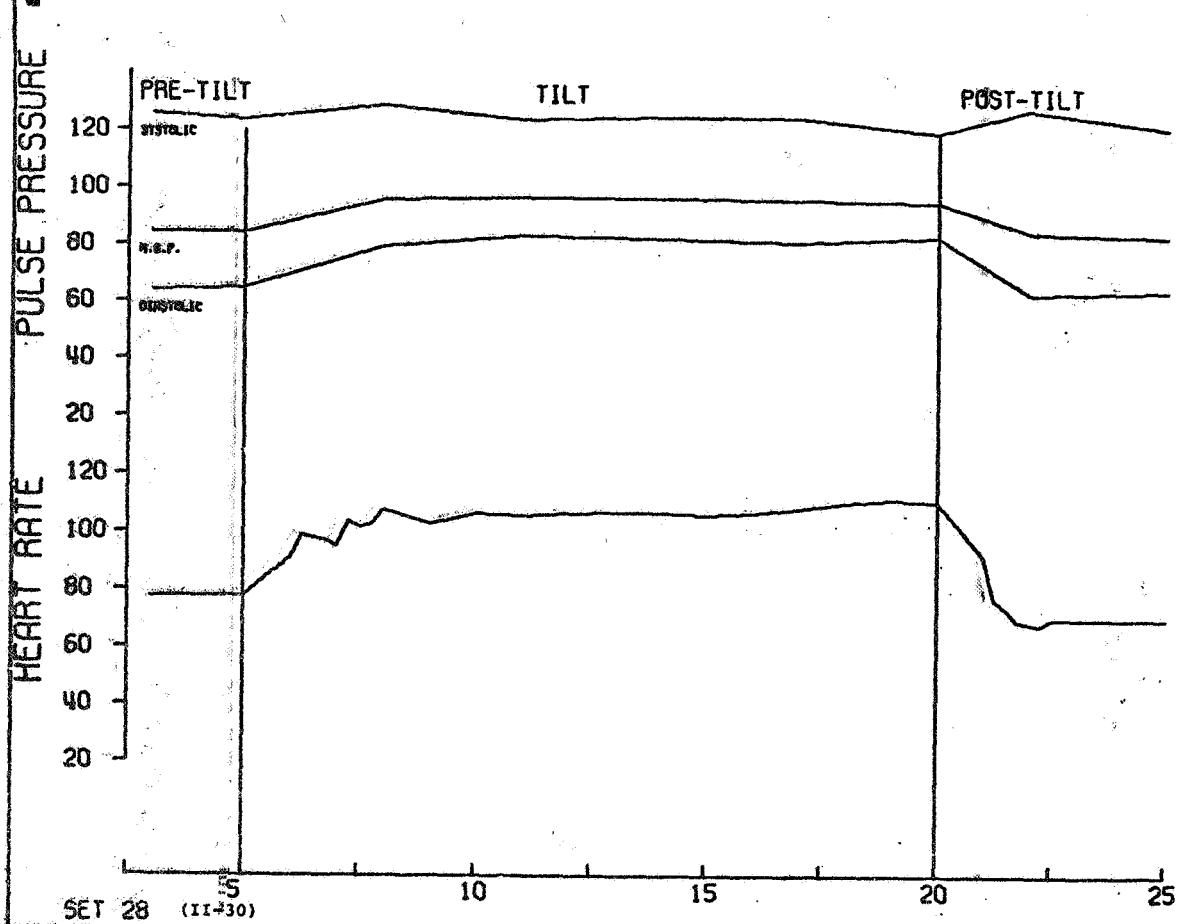
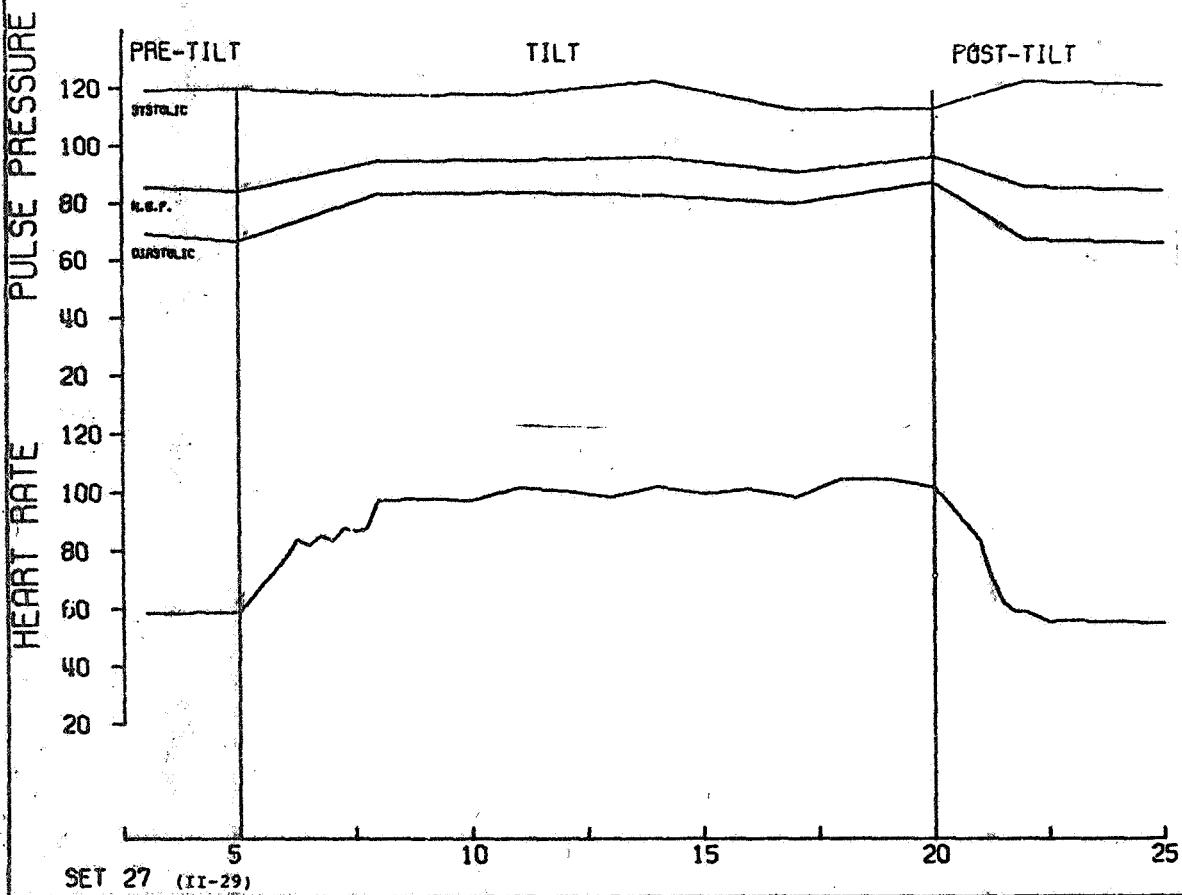


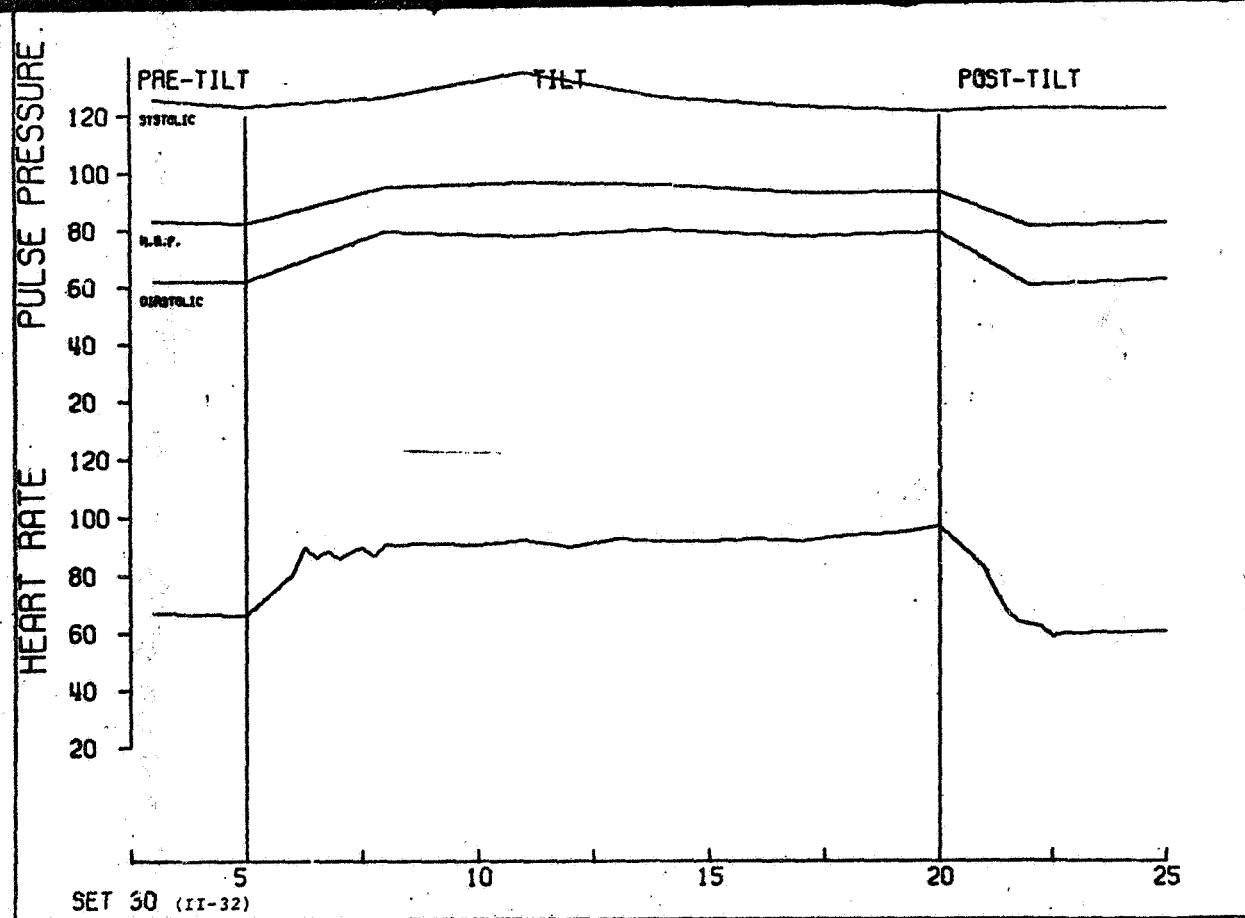
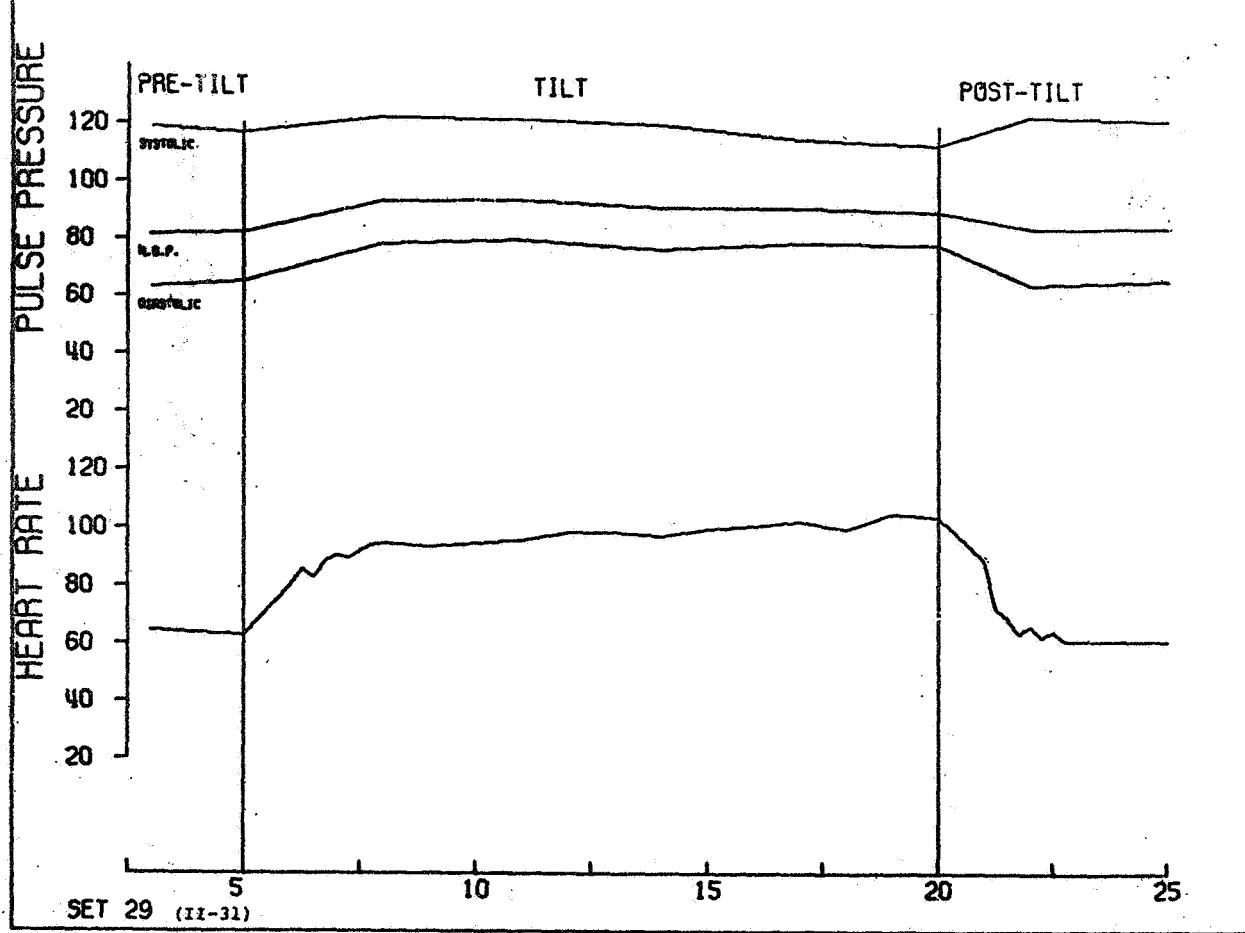


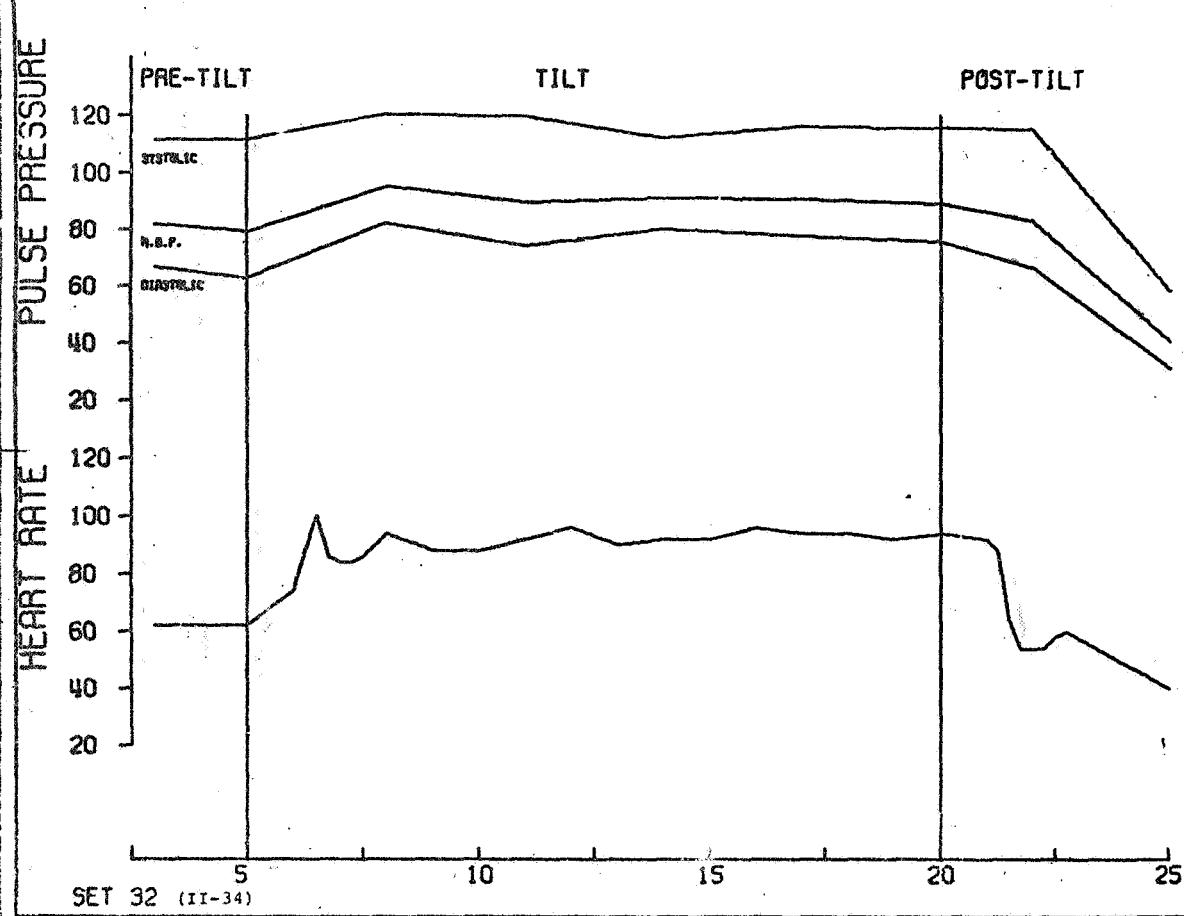
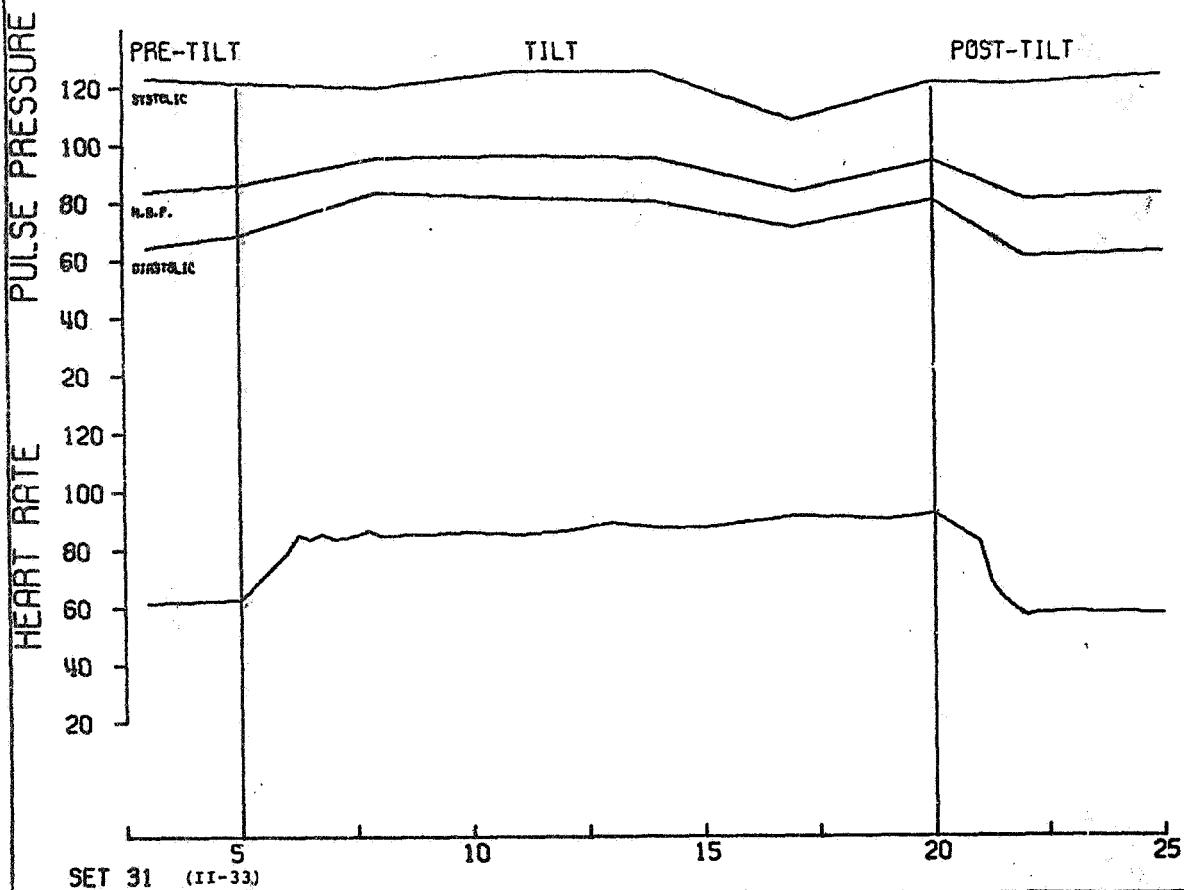


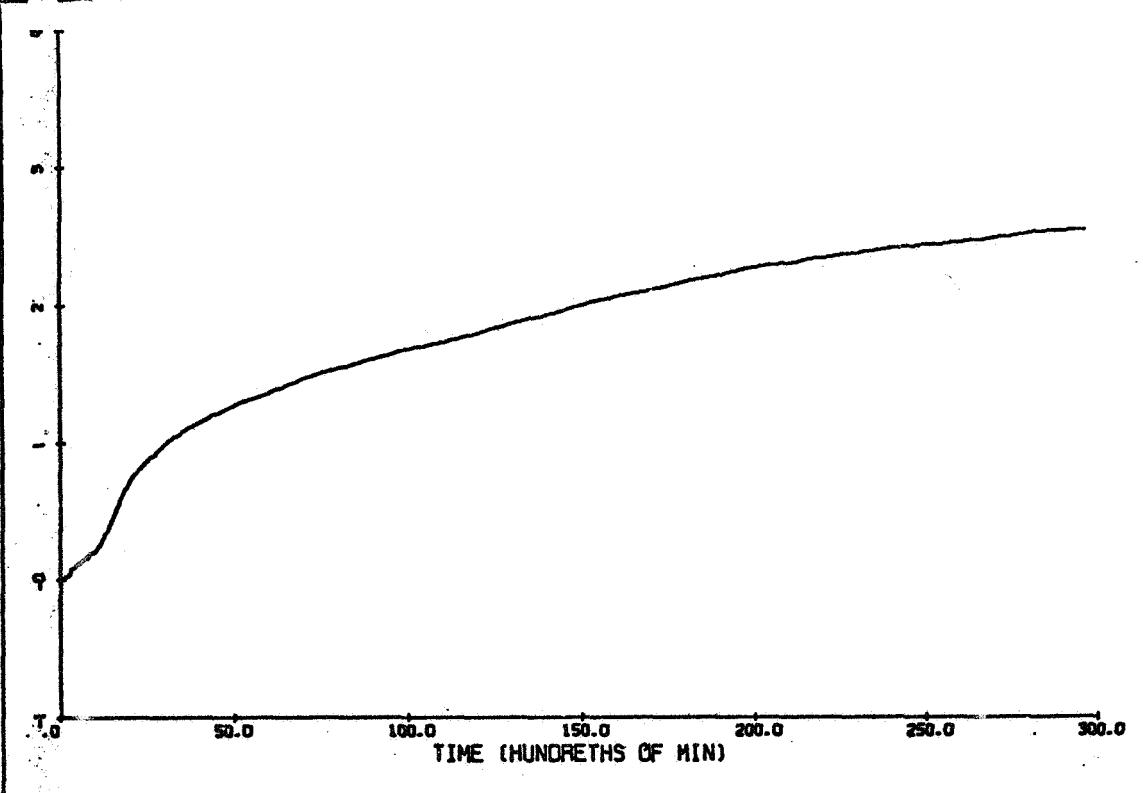
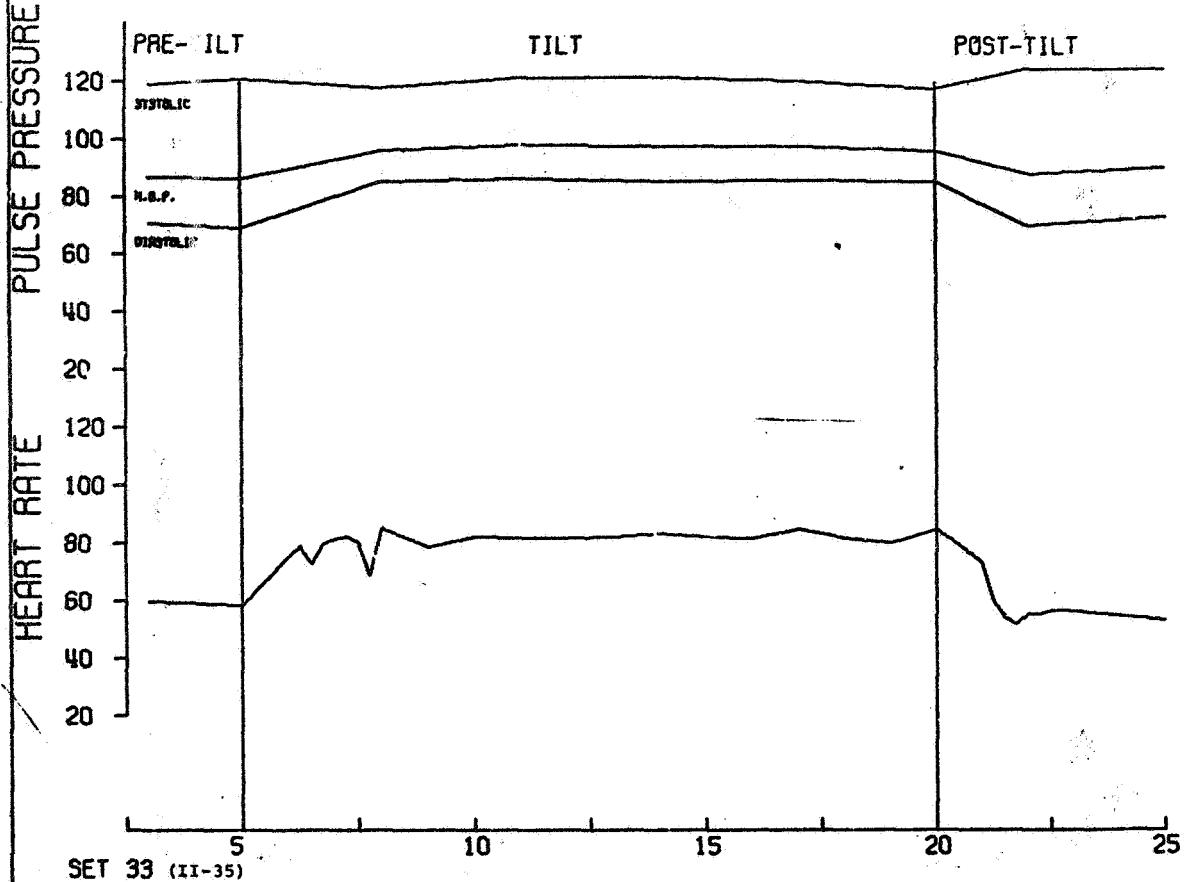


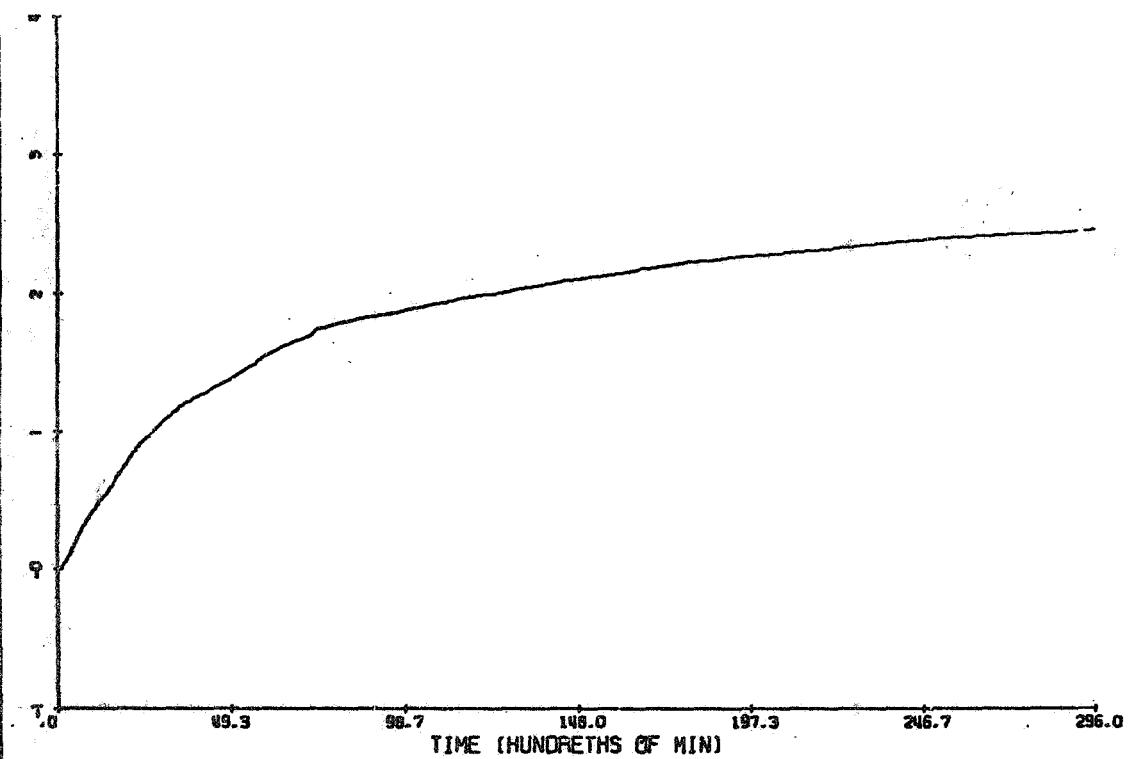






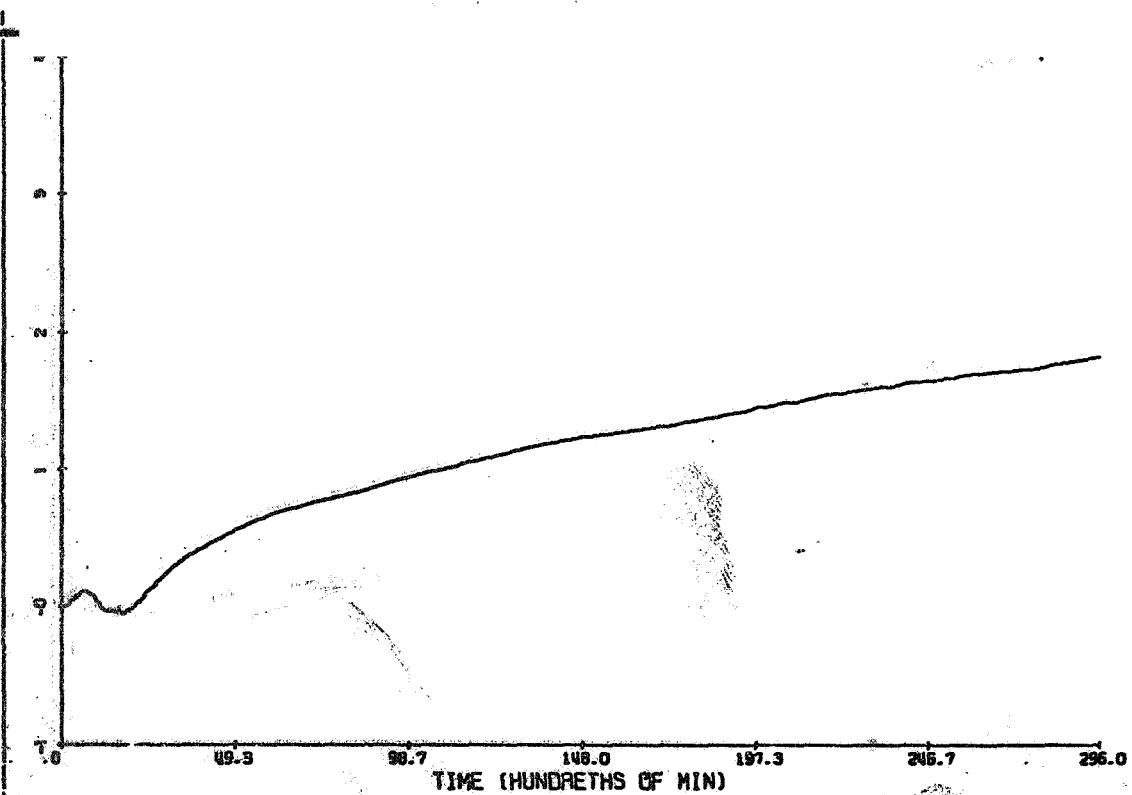




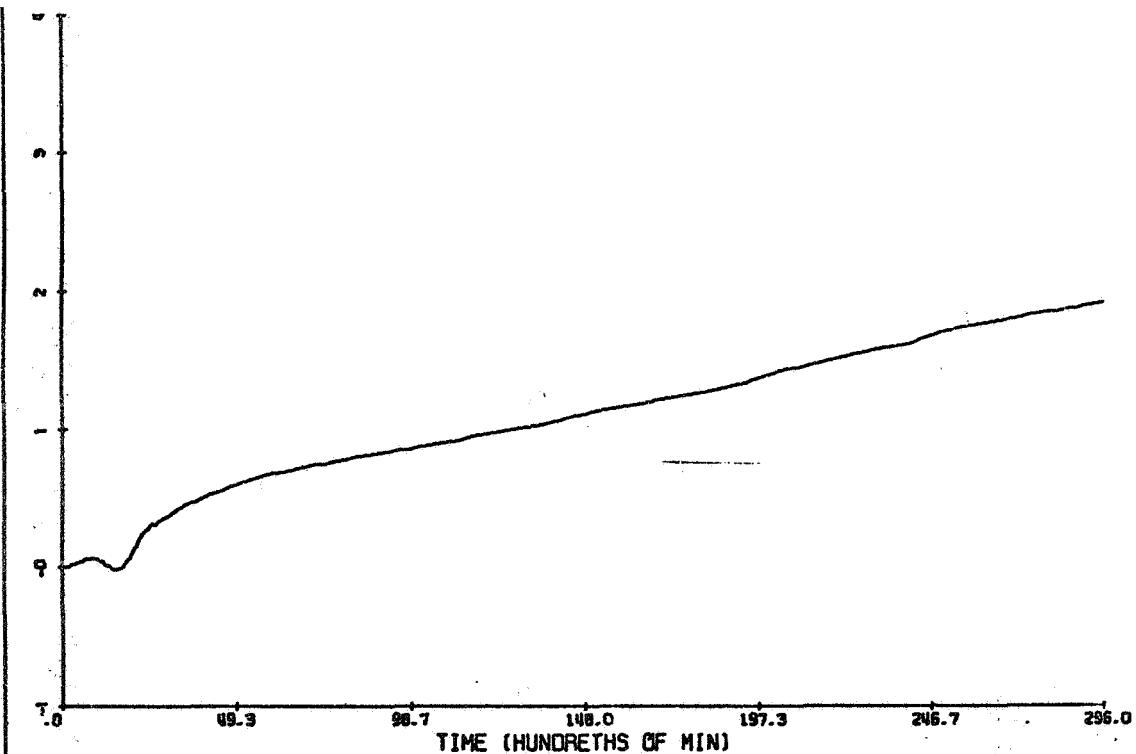


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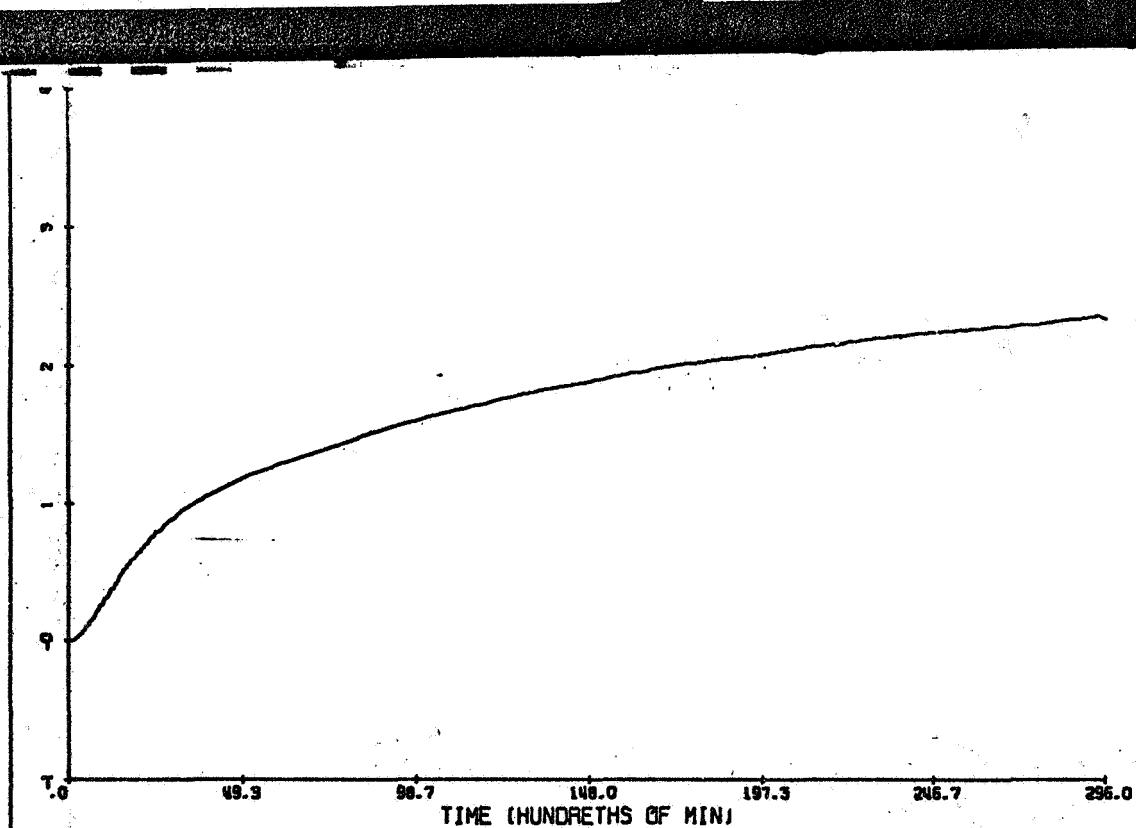
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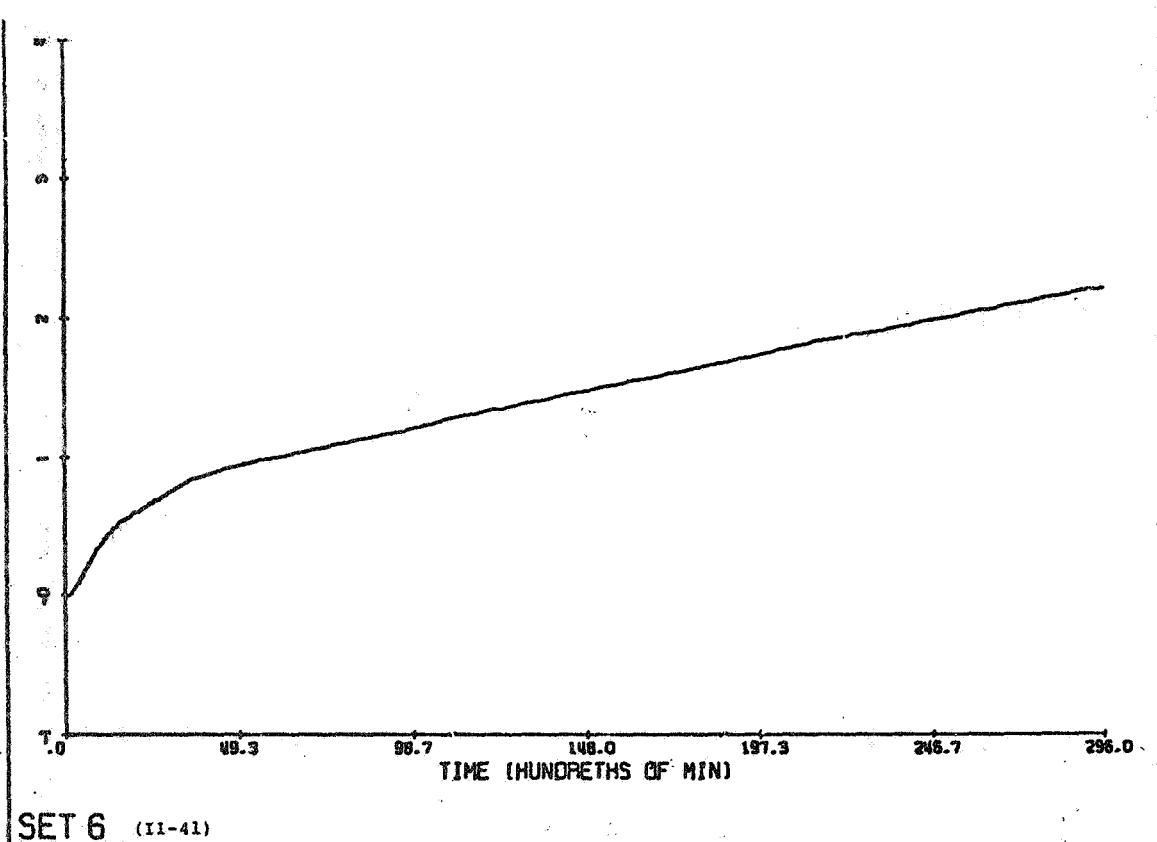
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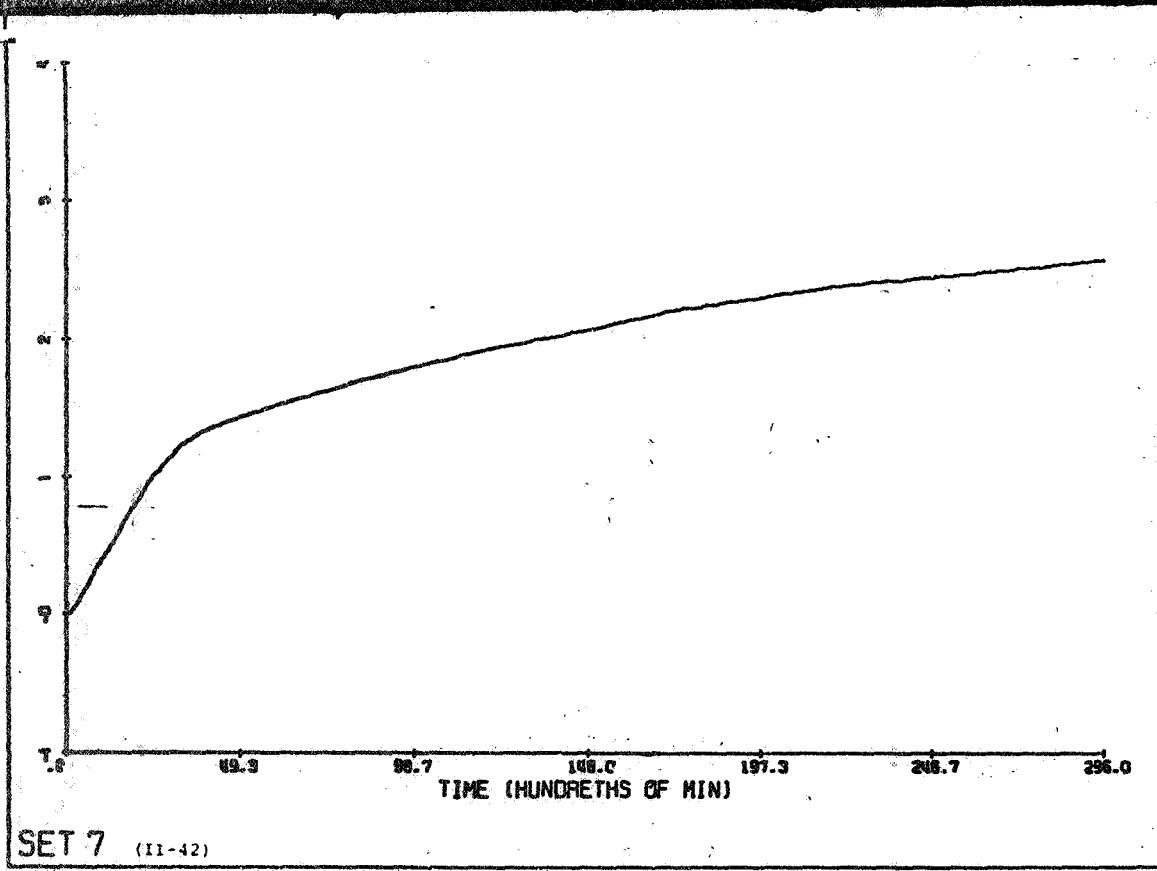
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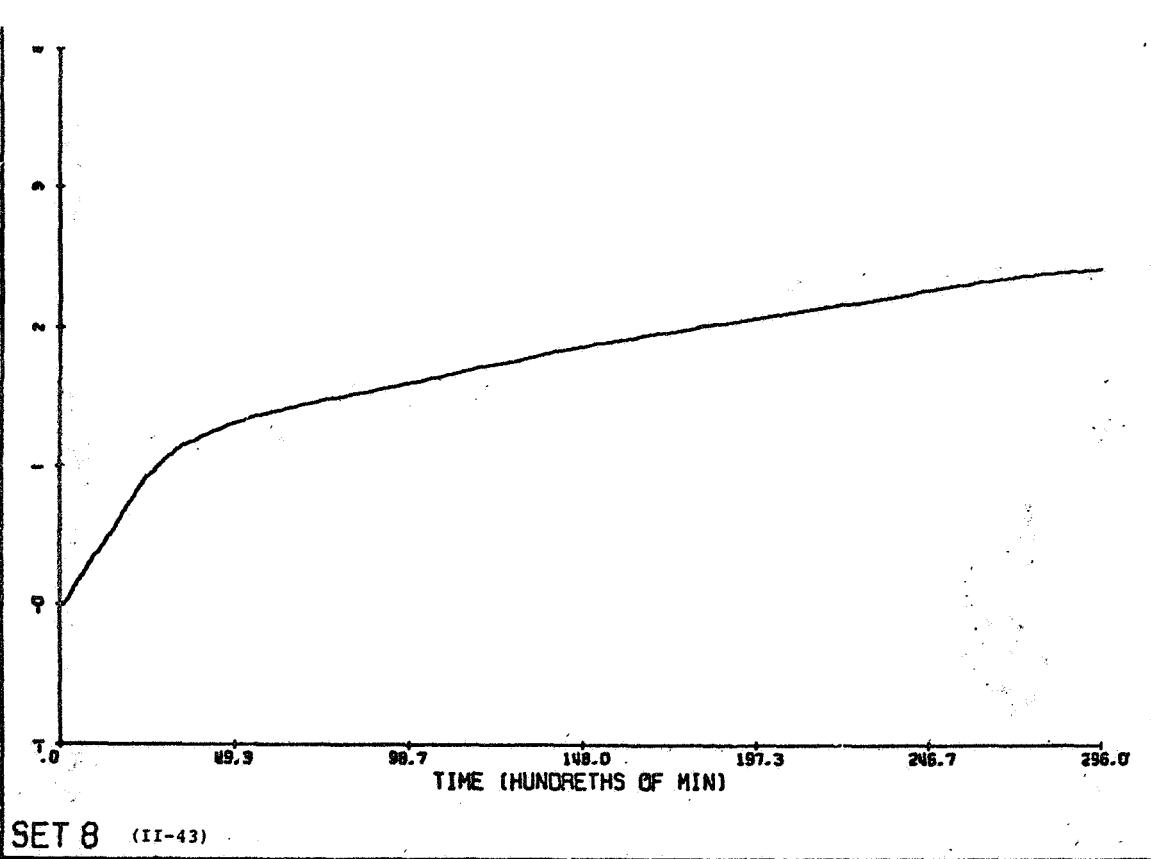
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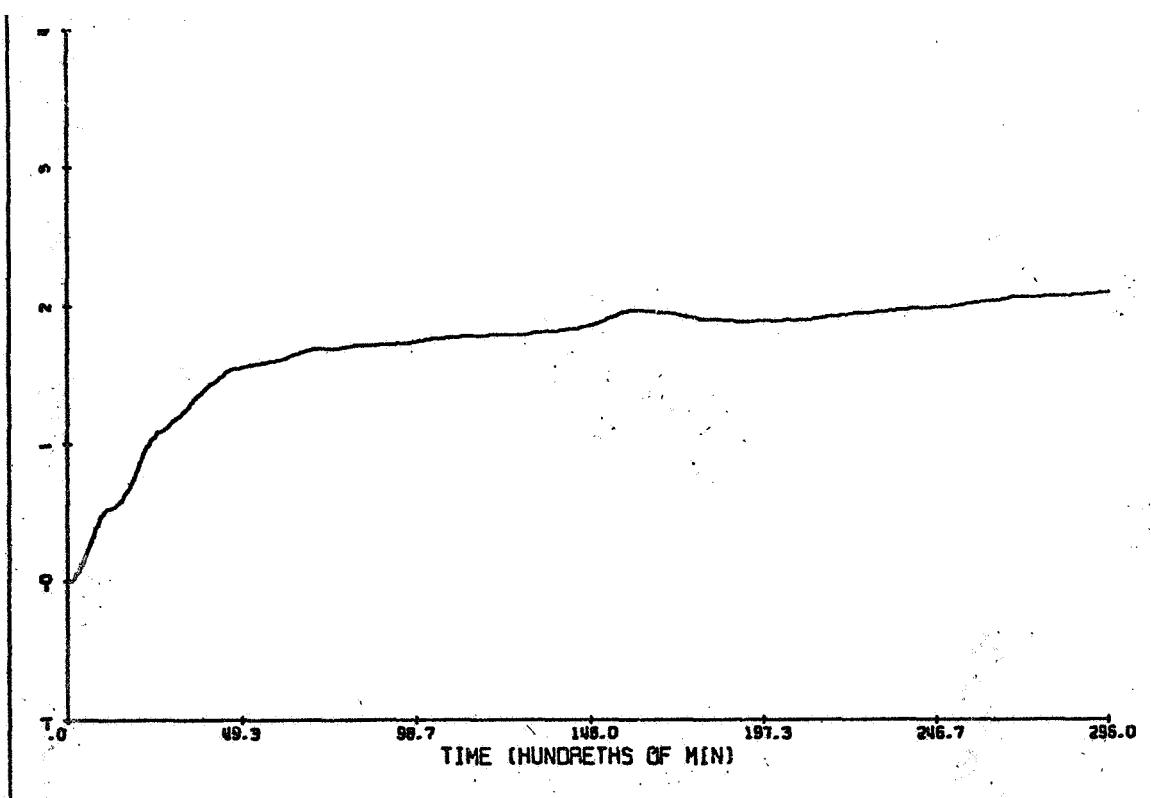
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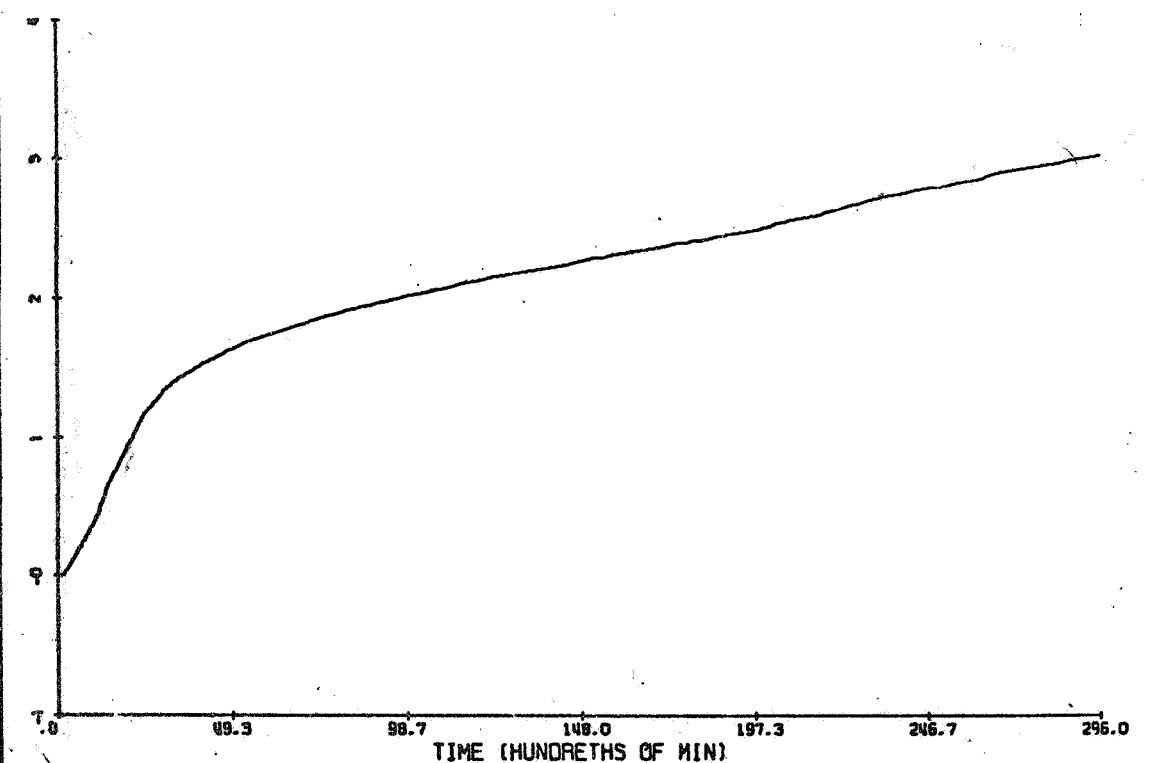
SET 7 (II-42)



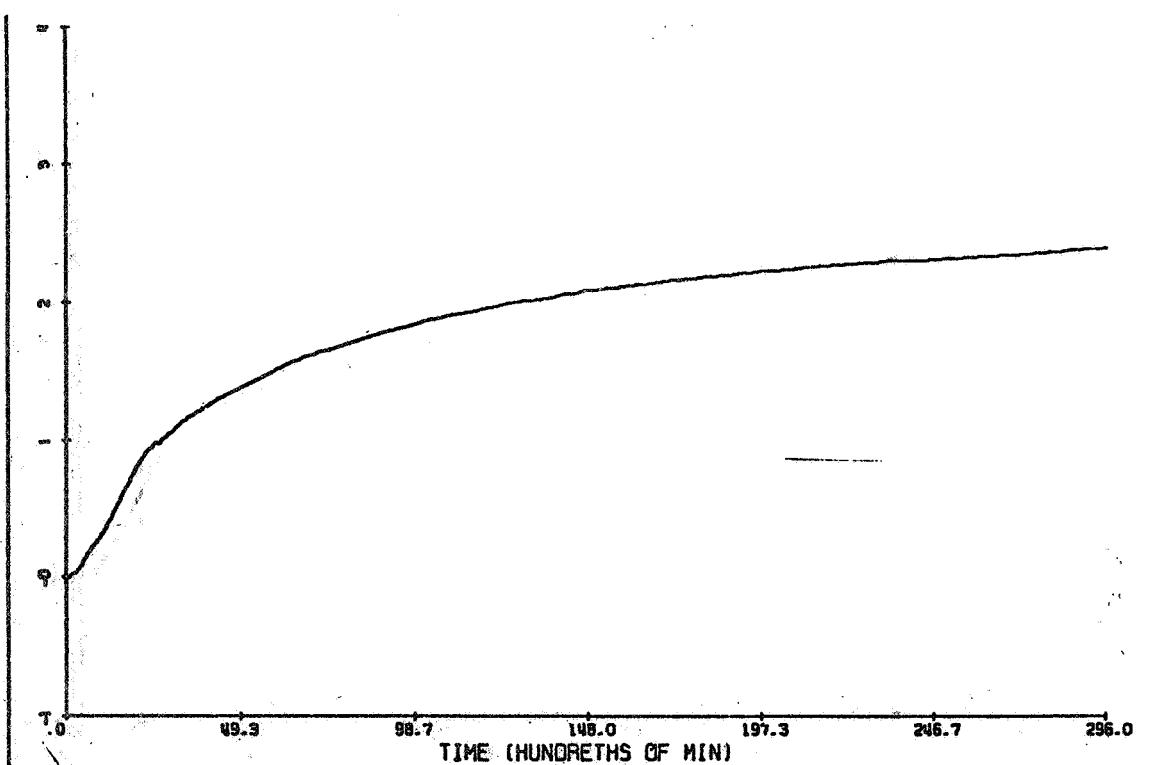
SET 8 (II-43)



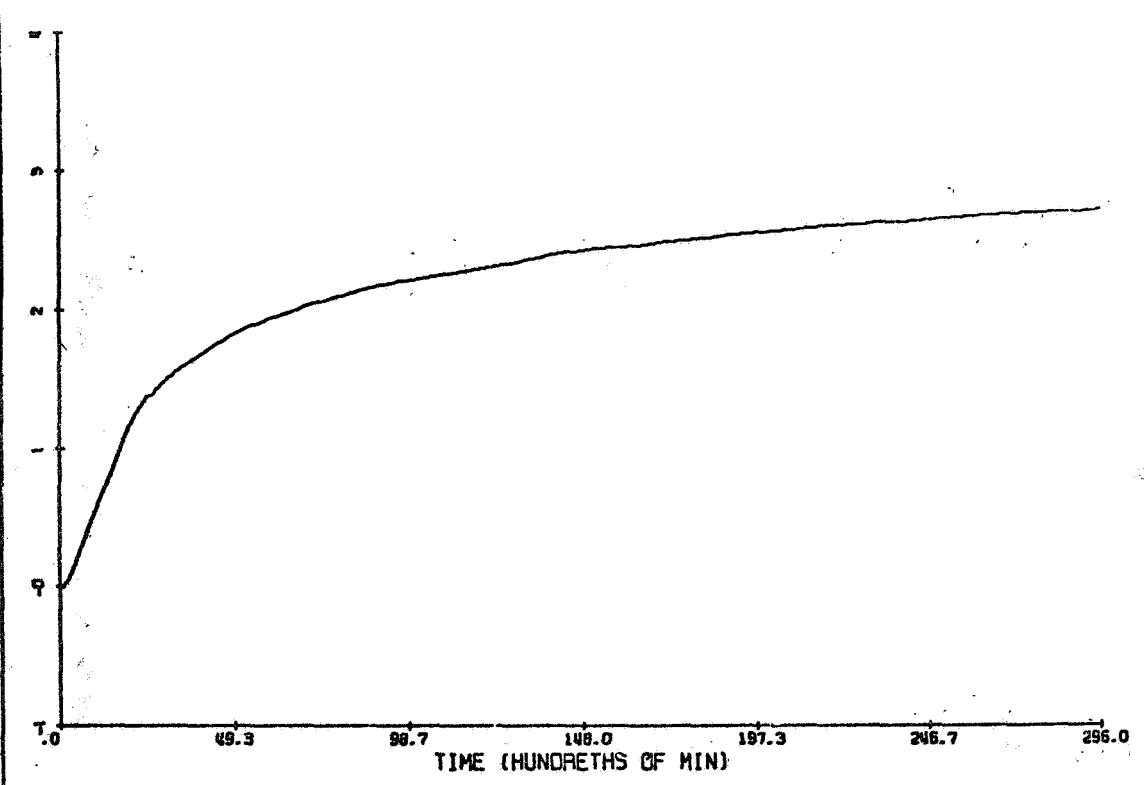
SET 9 (II-44)



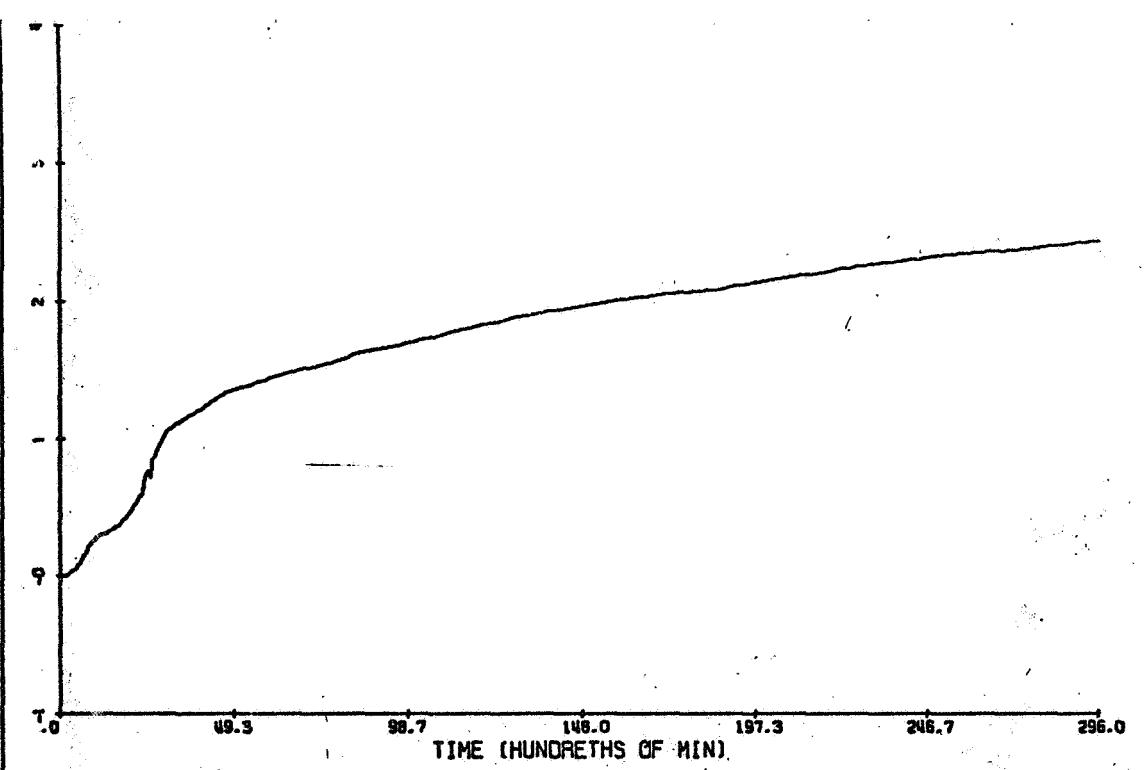
SET 10 (II-45)



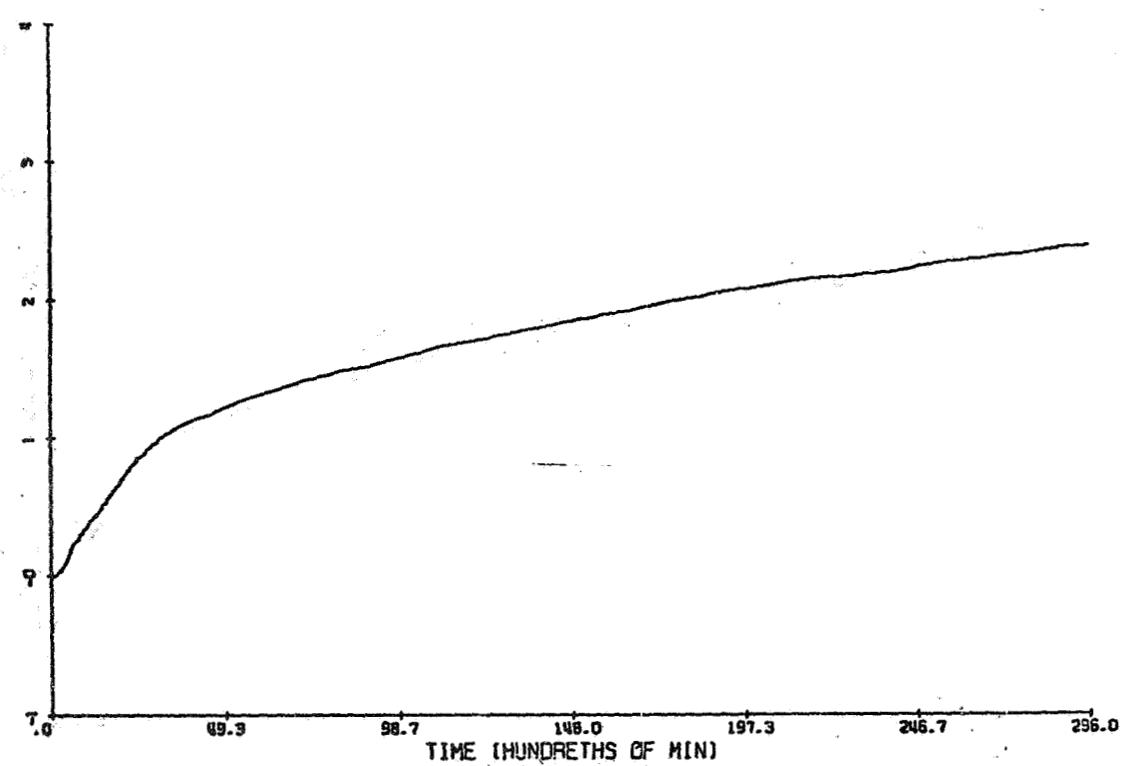
SET 11 (II-46)



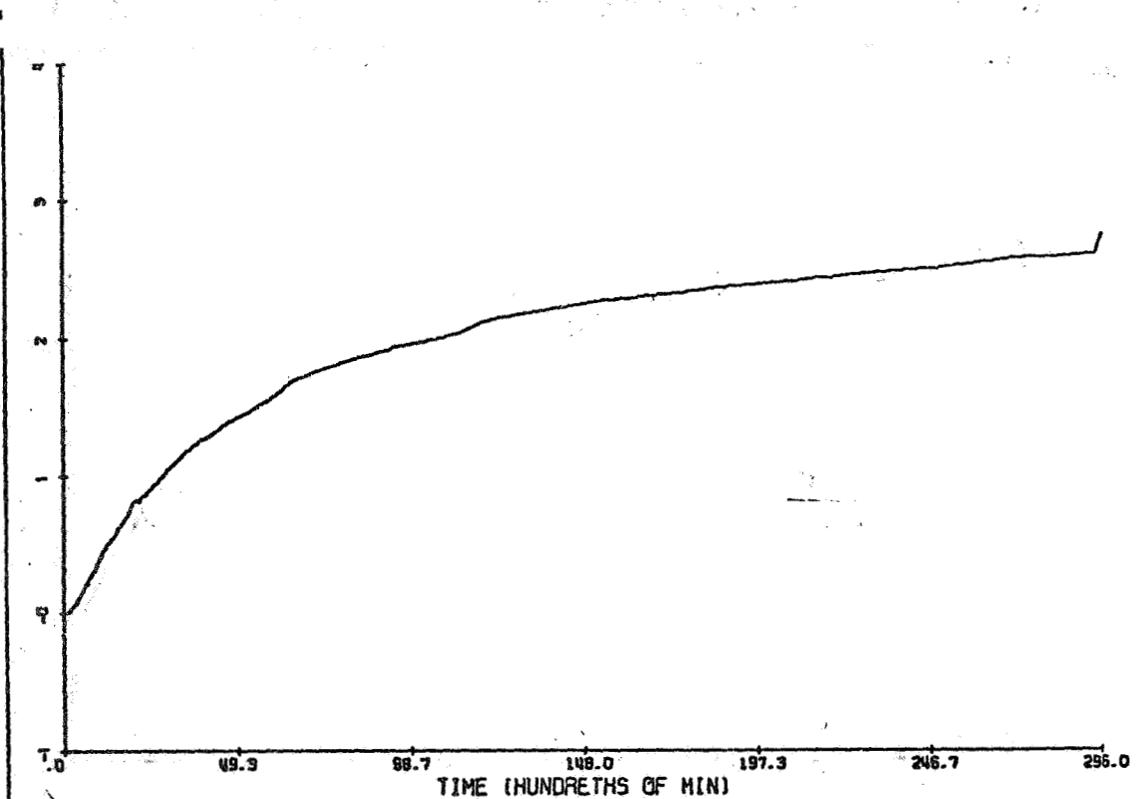
SET 12 (II-47)



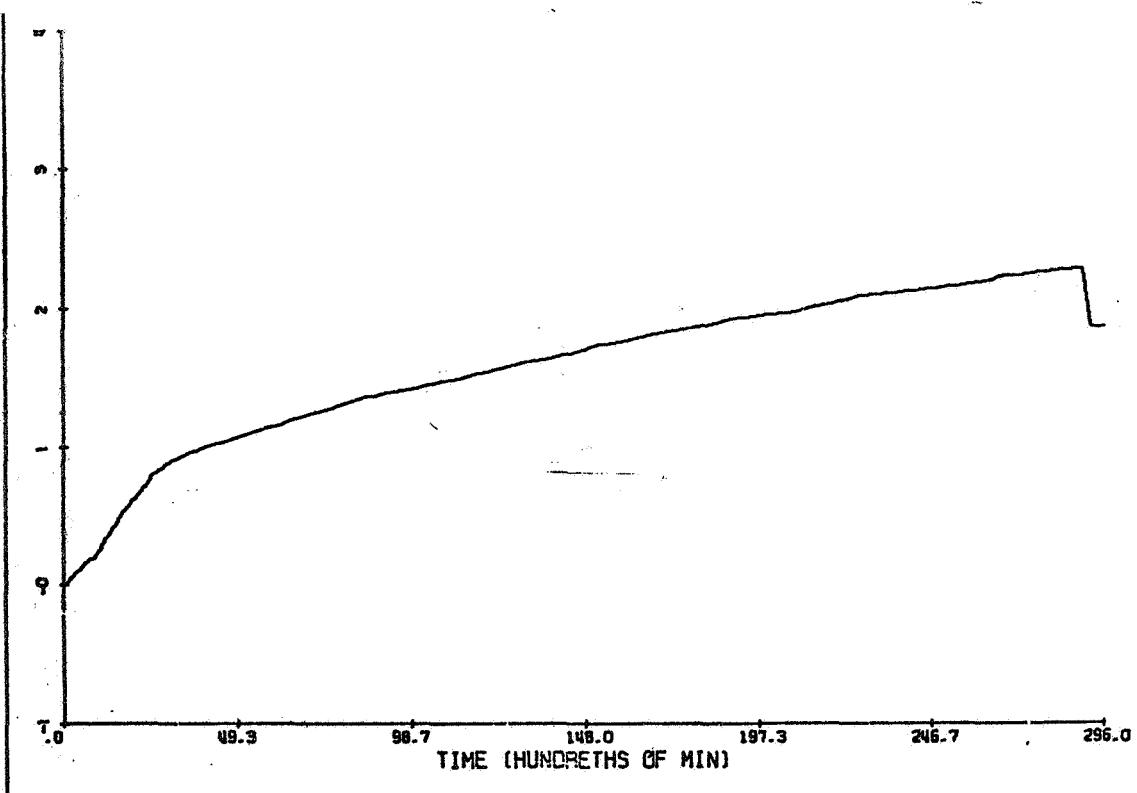
SET 13 (II-48)



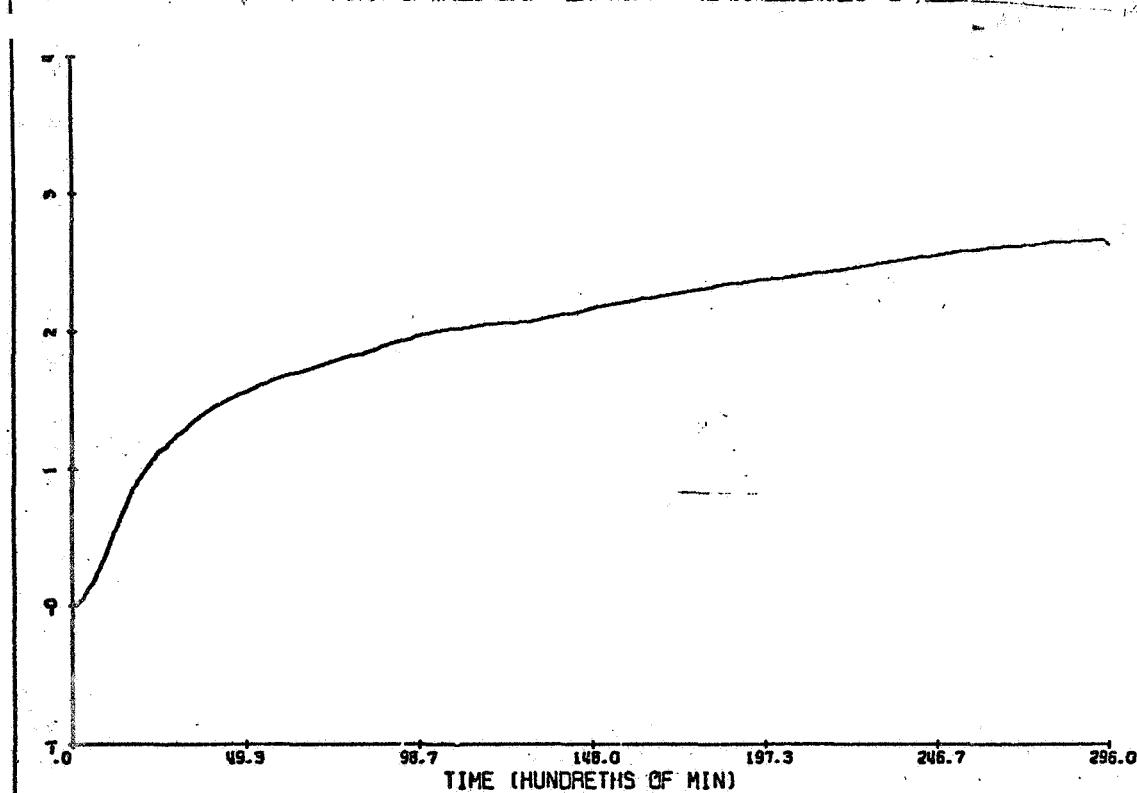
SET 14 (II-49)



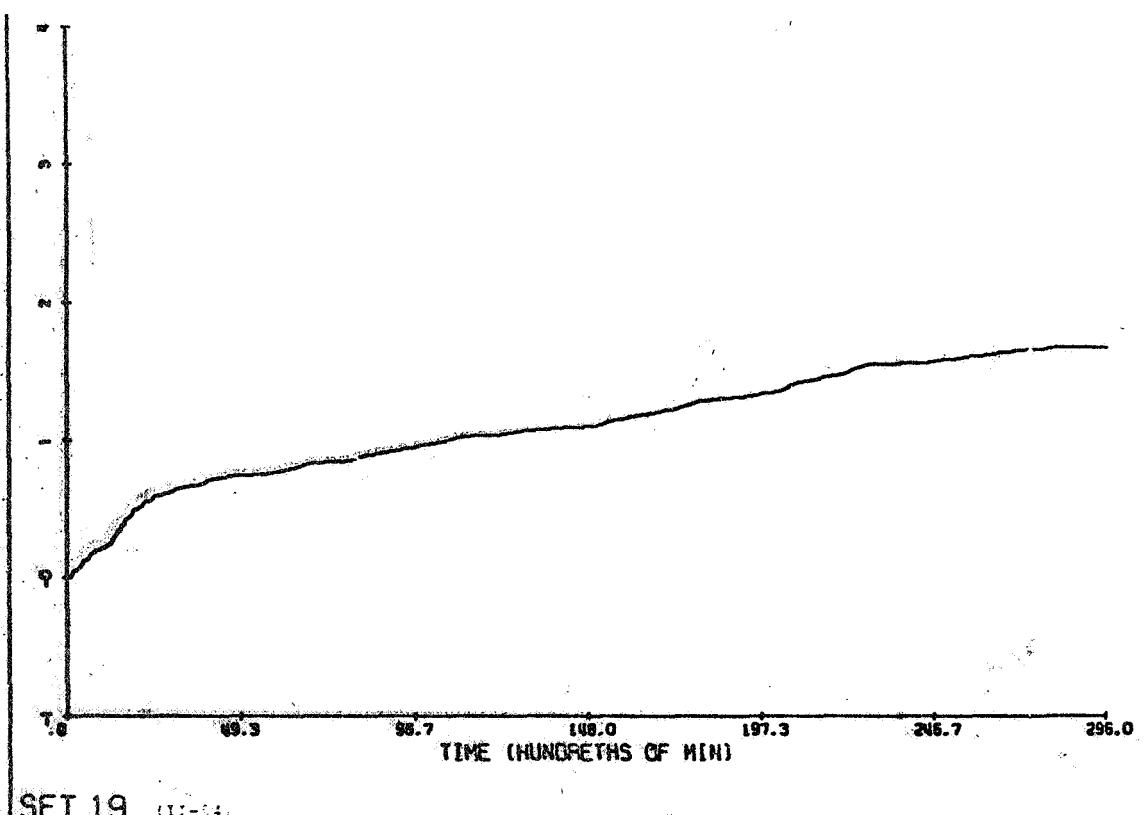
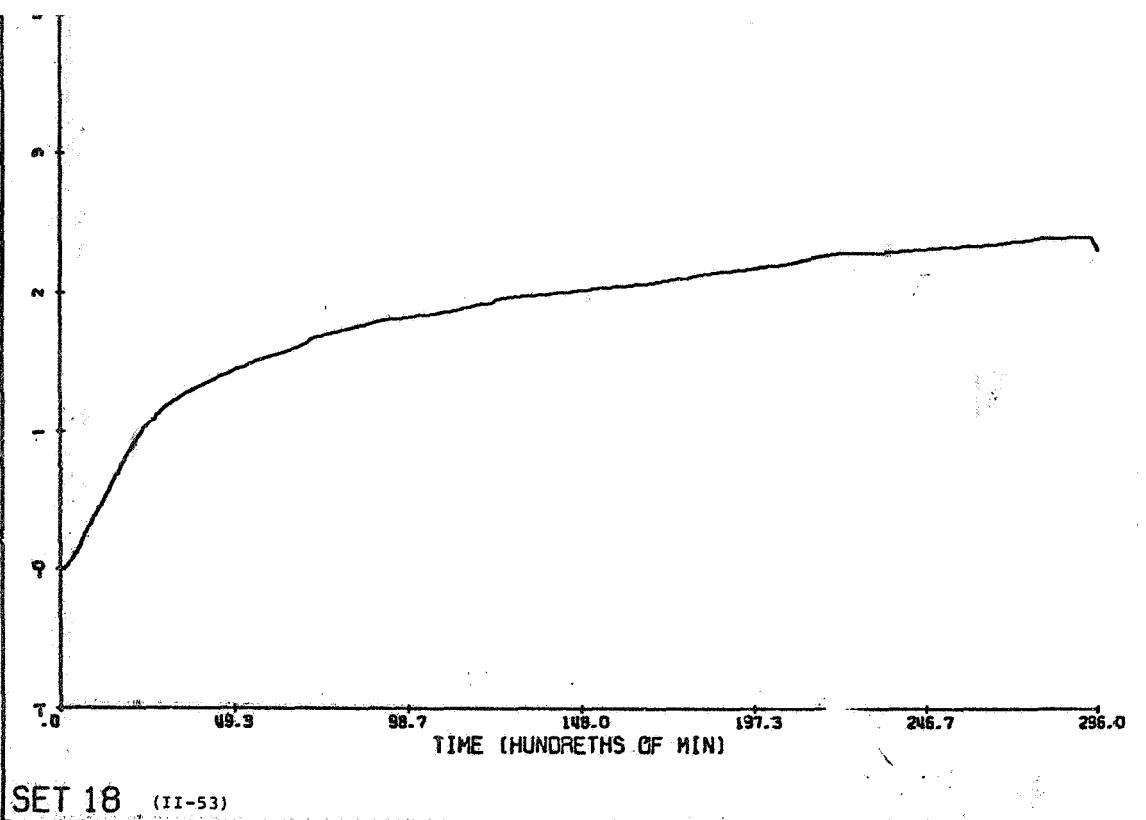
SET 15 (II-50)

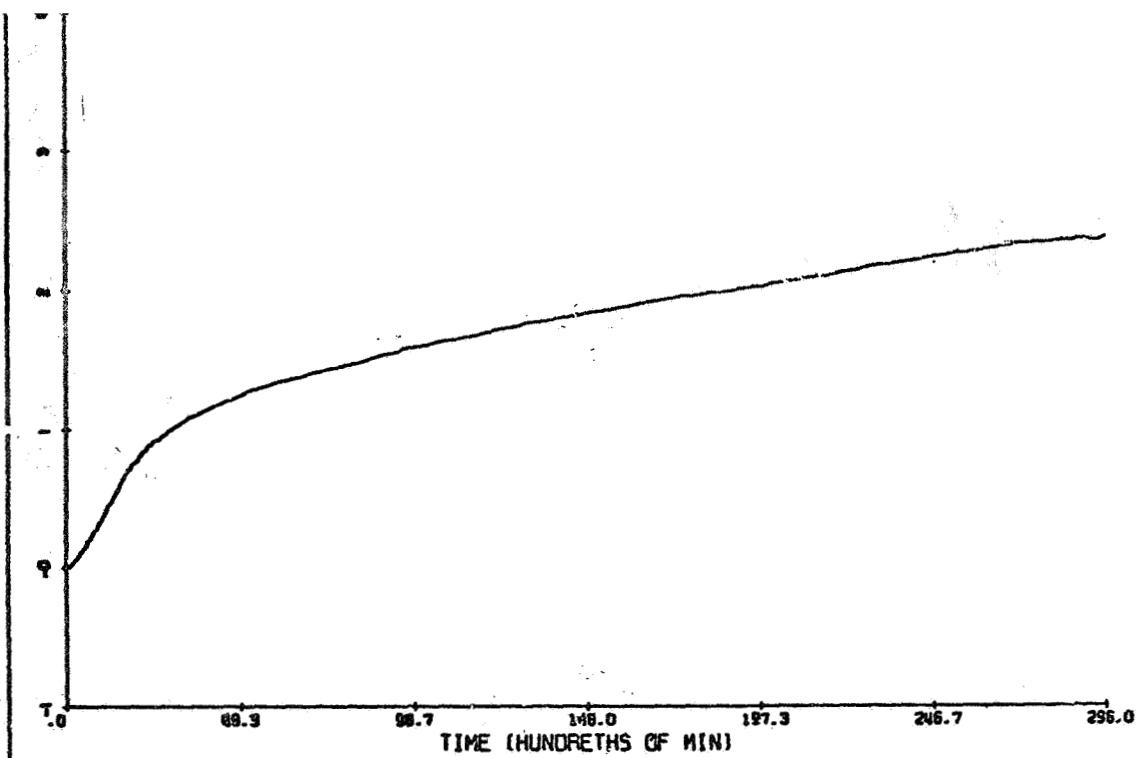


SET 16 (II-51)

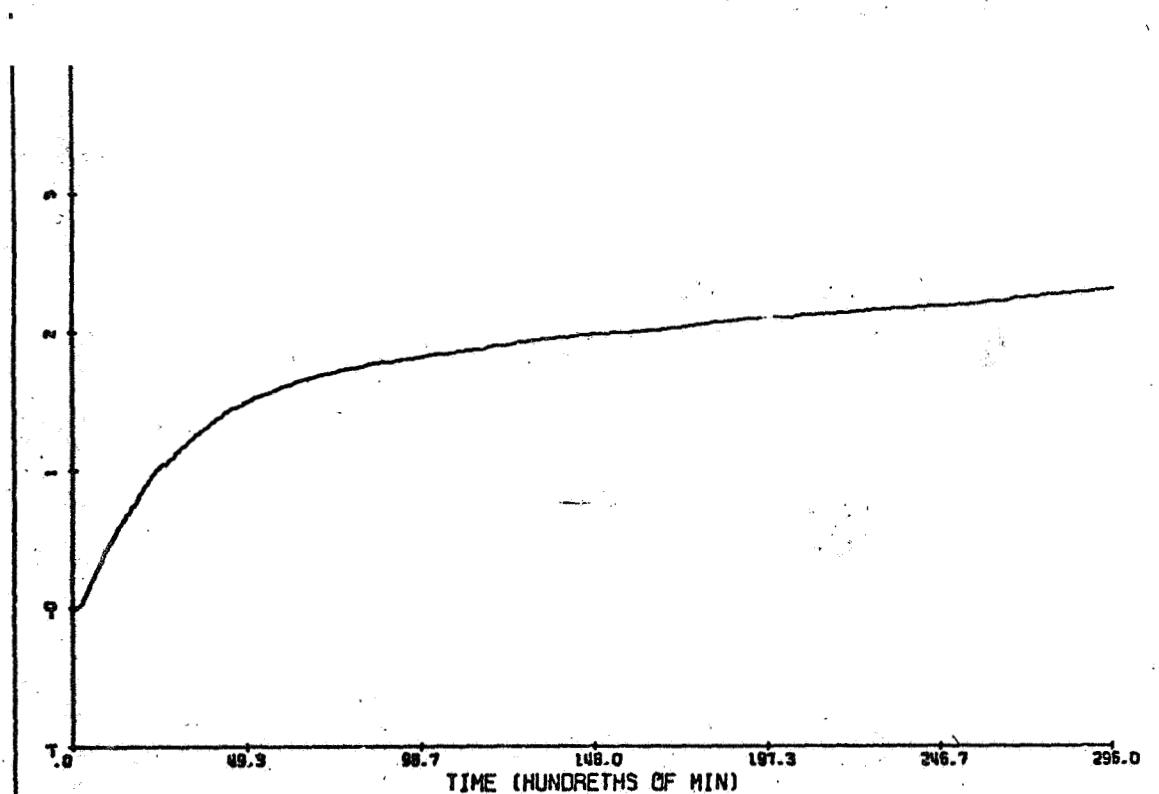


SET 17 (II-52)

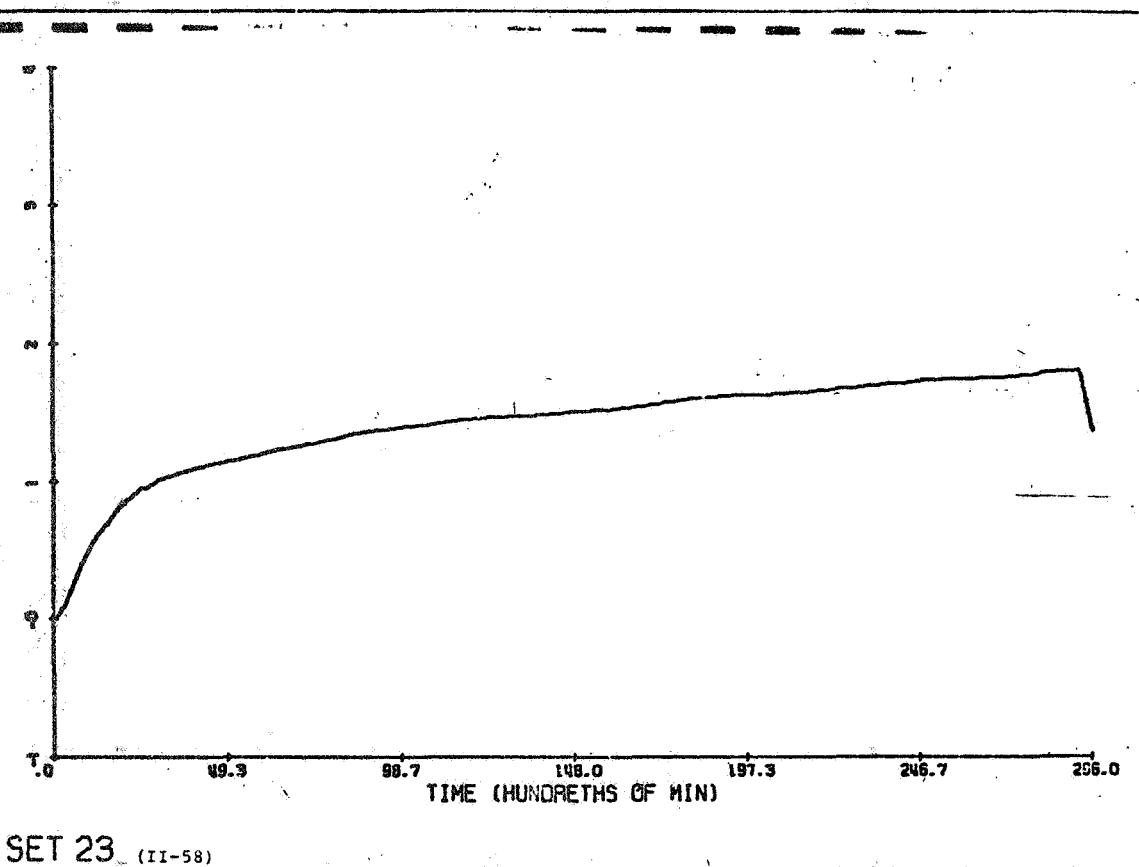
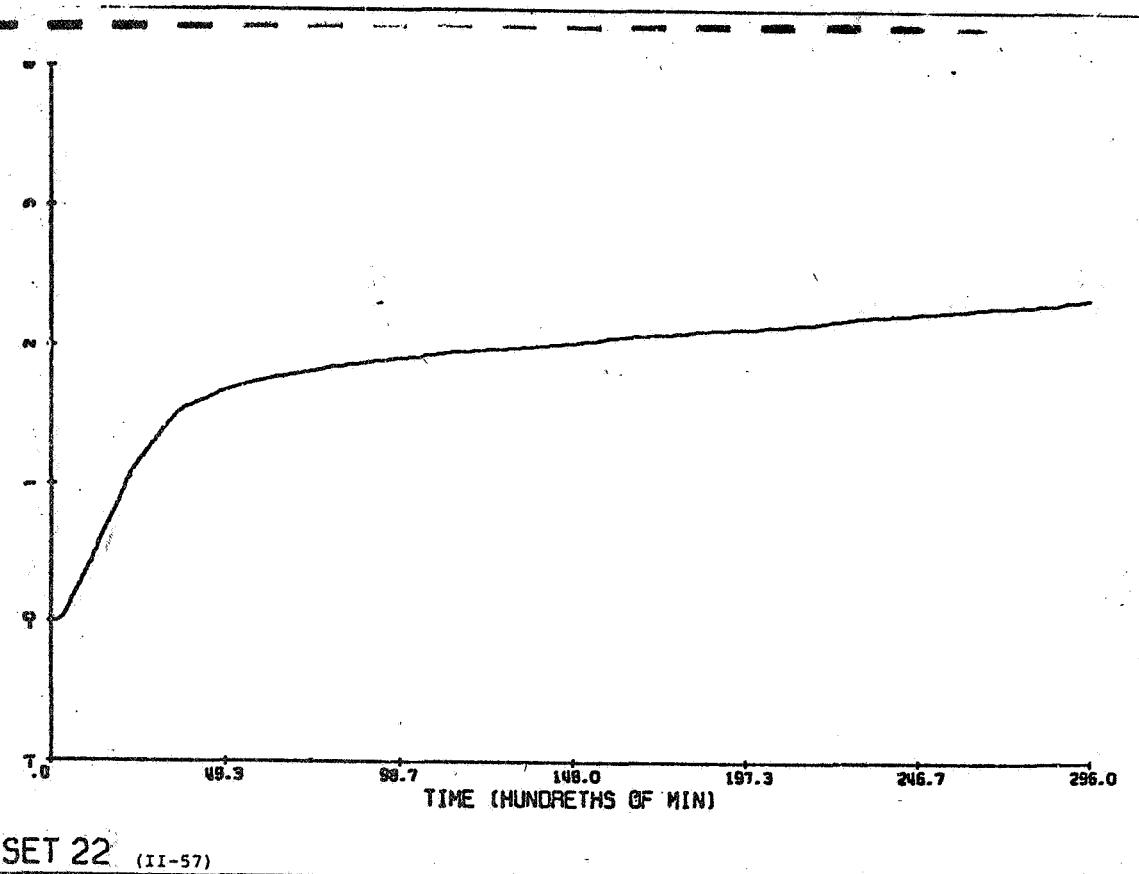


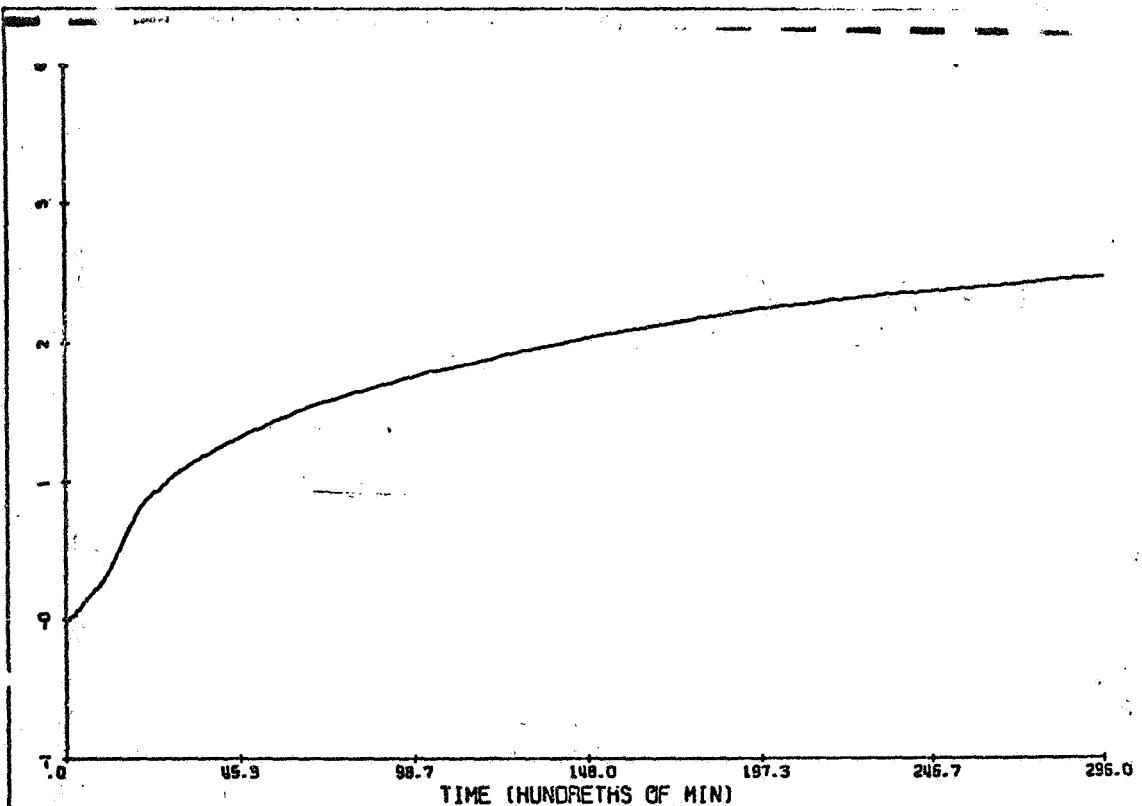


SET 20 (II-55)

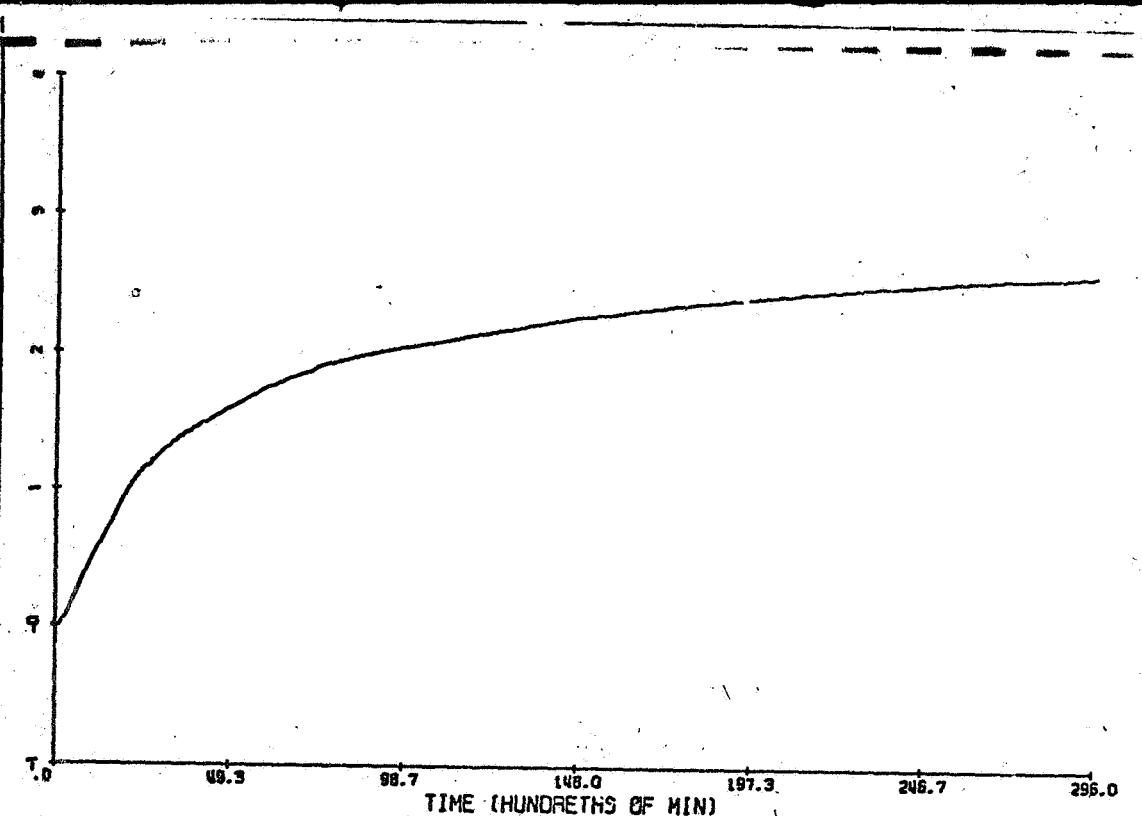


SET 21 (II-56)

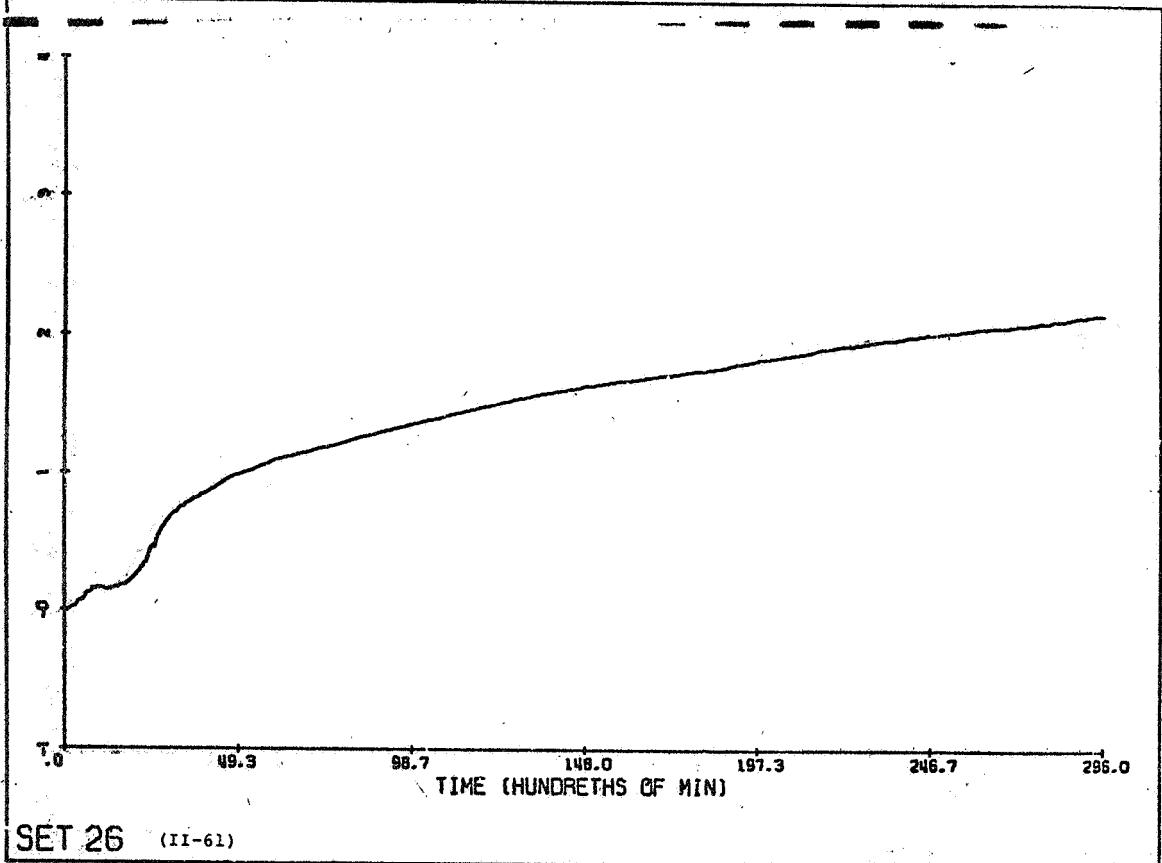




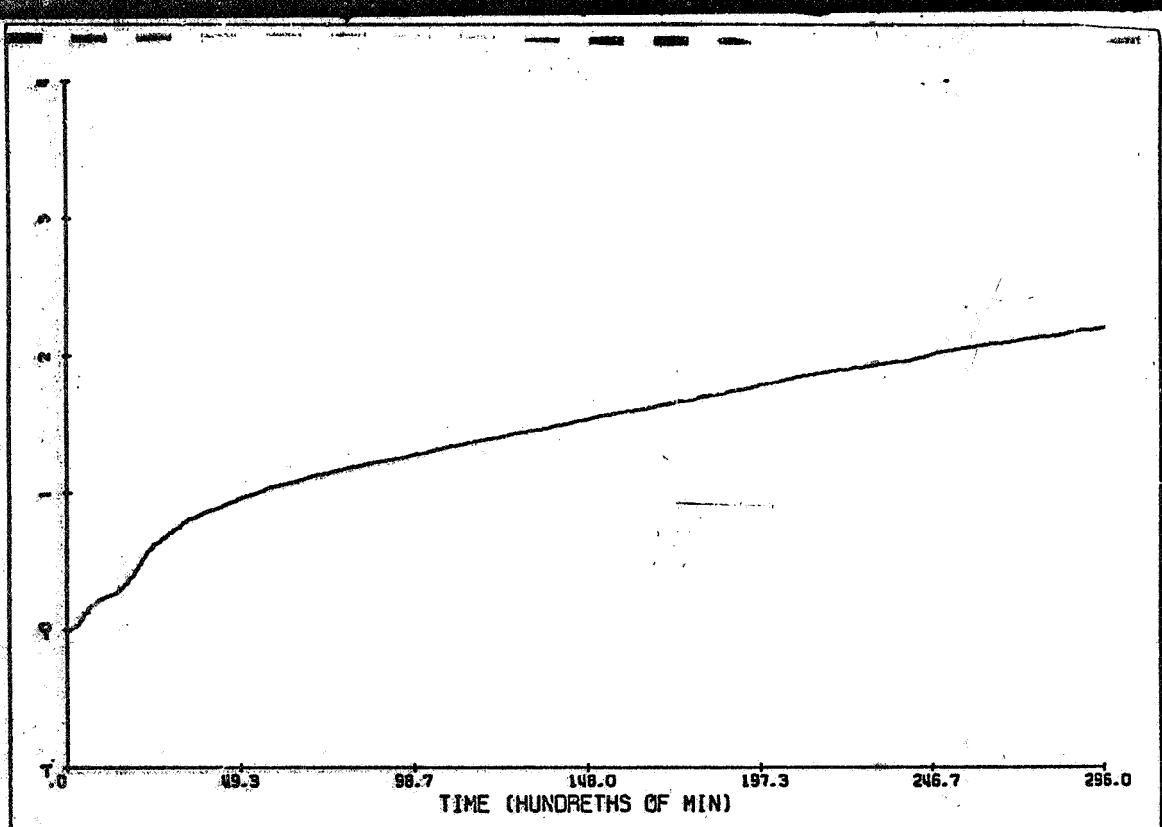
SET 24 (II-59)



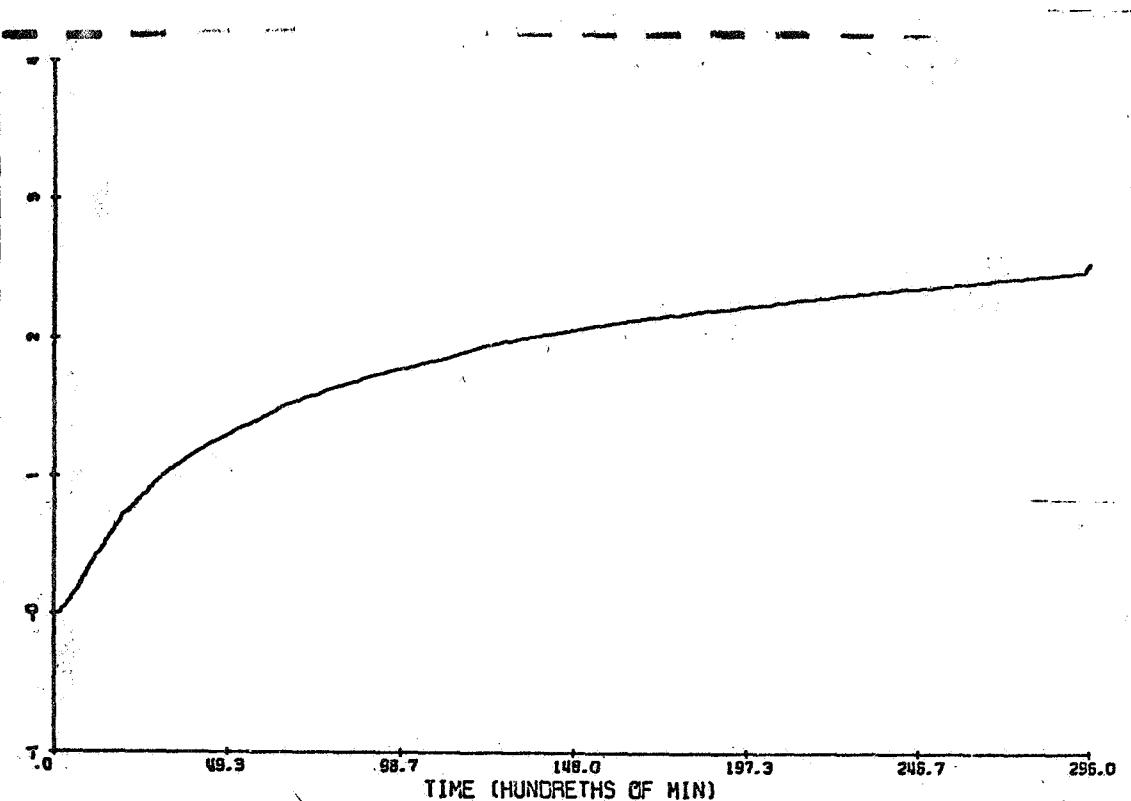
SET 25. (II-60)



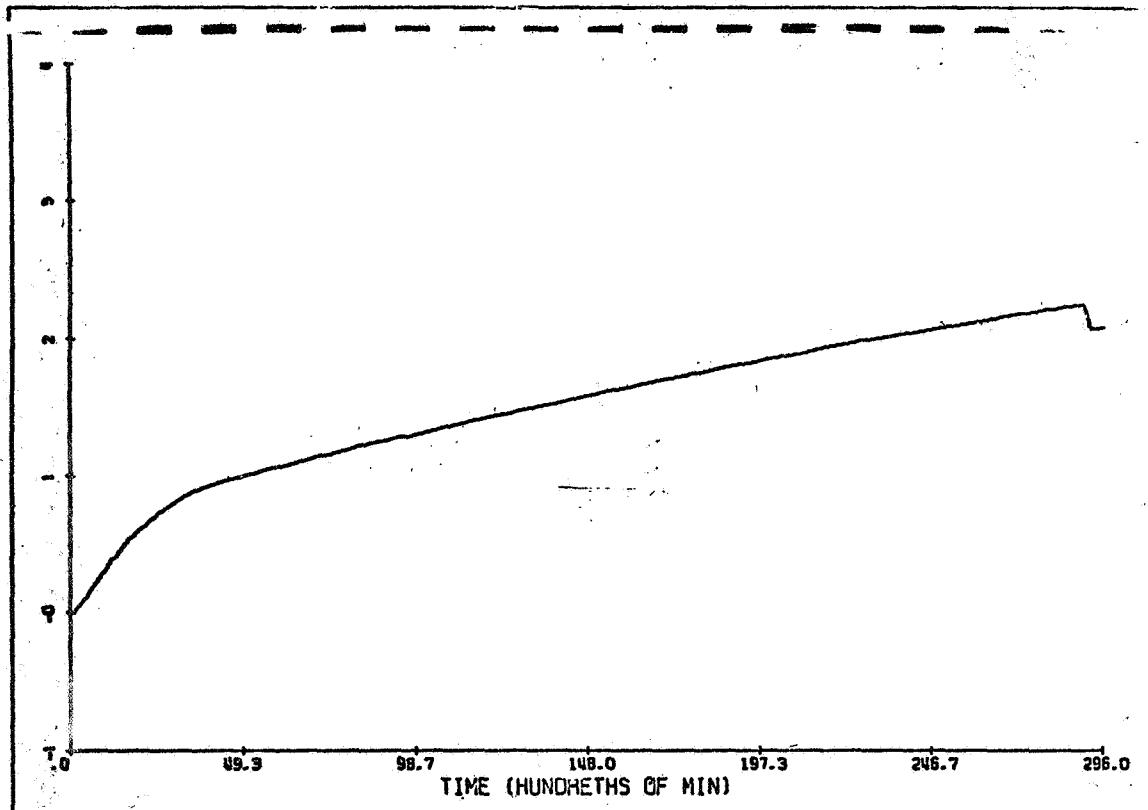
SET 26 (II-61)



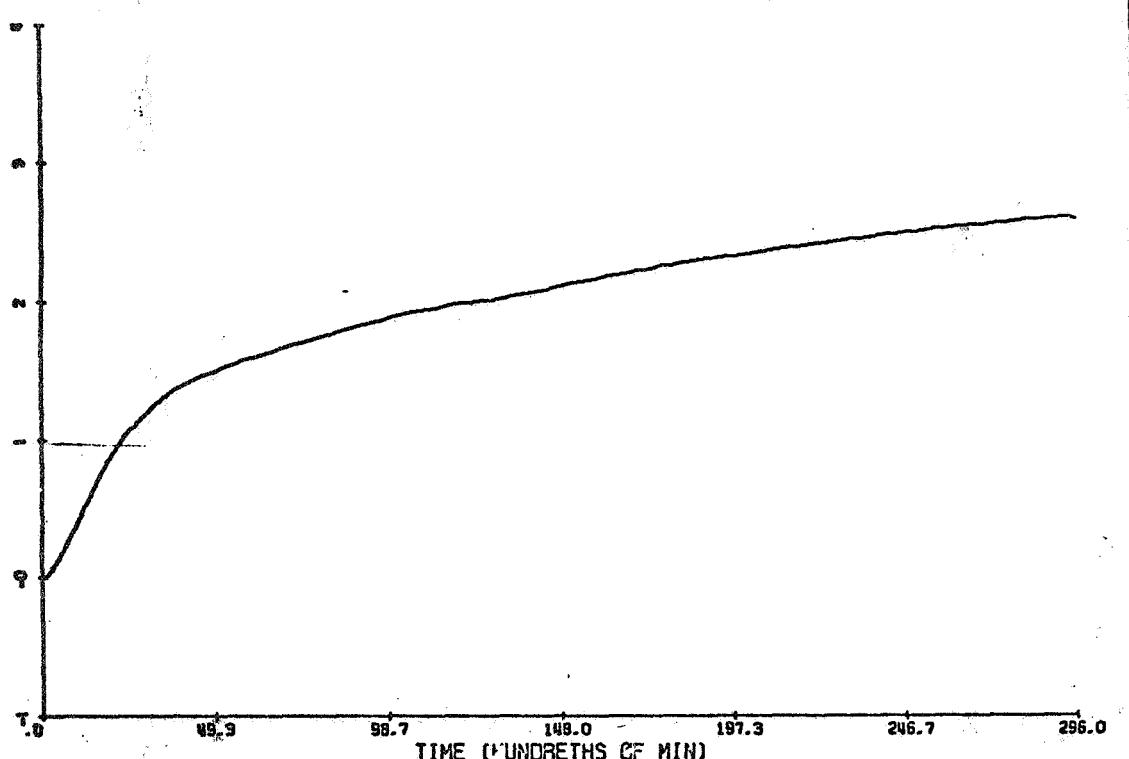
SET 27 (II-62)



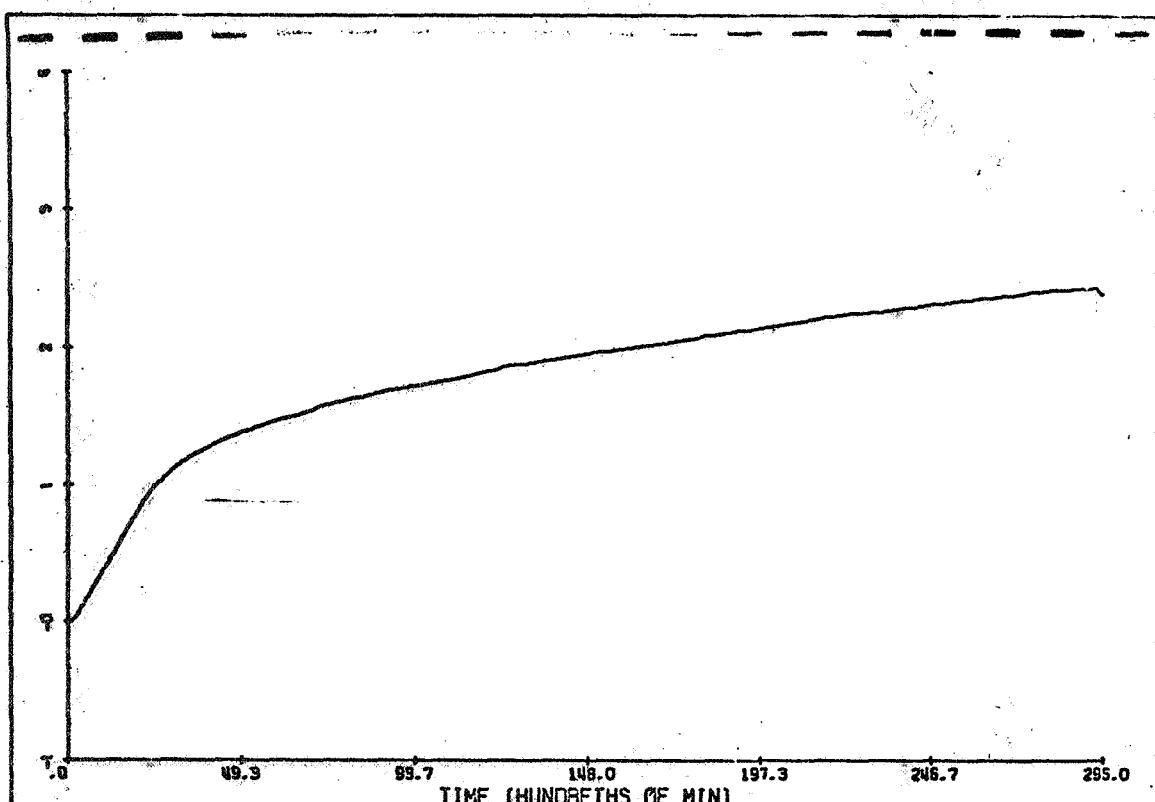
SET 28 (II-63)



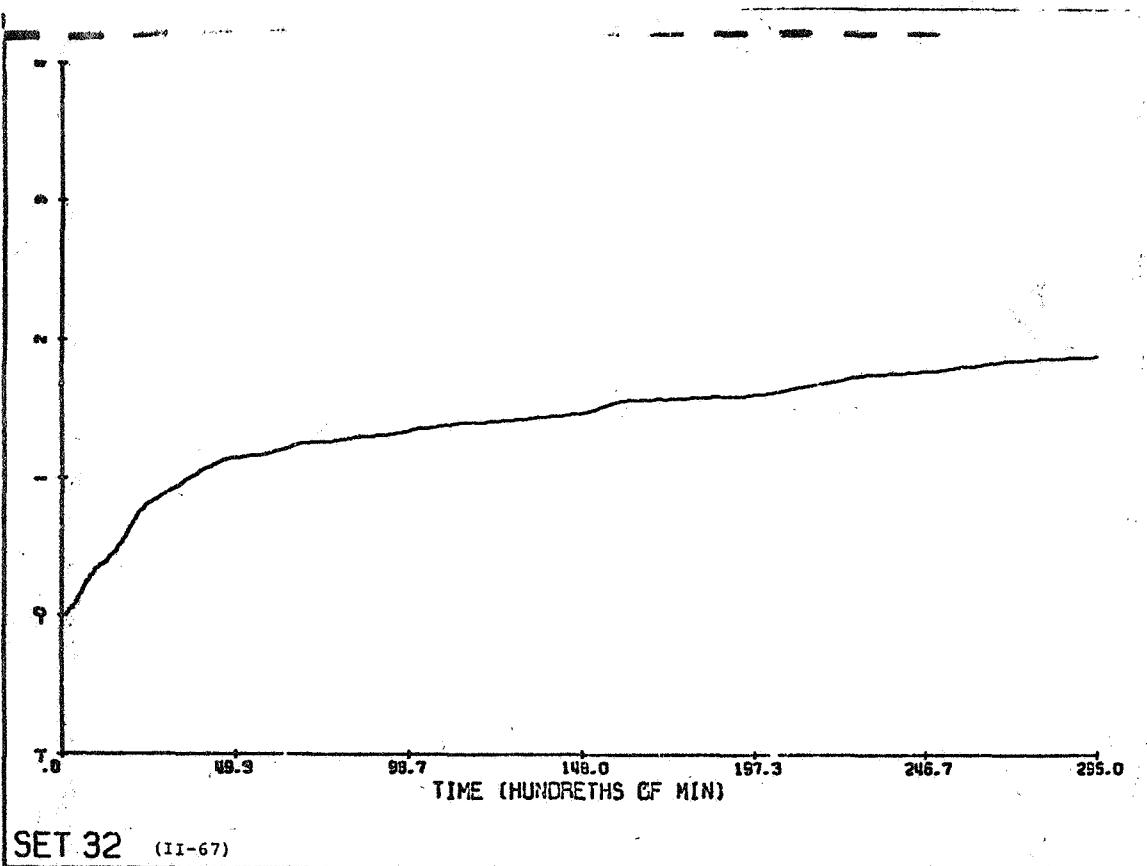
SET 29 (II-64)



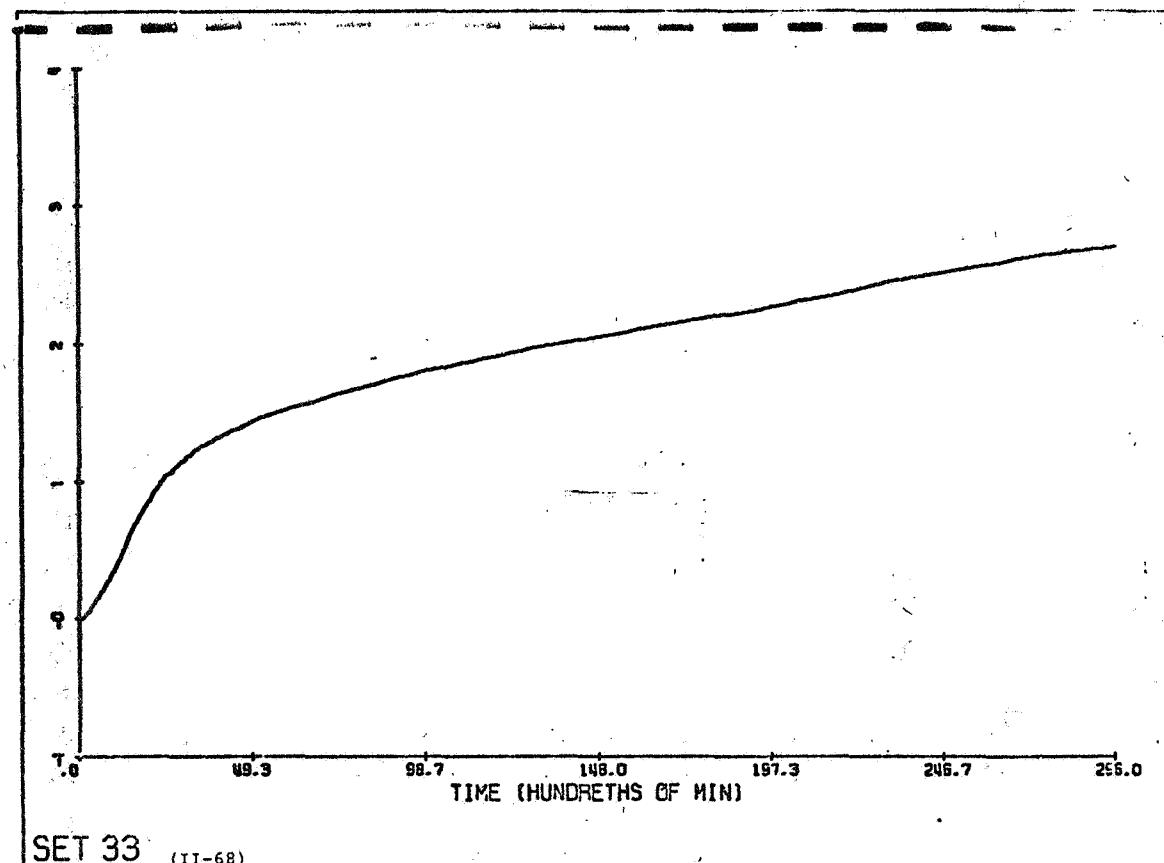
SET 30 (II-65)



SET 31 (II-66)



SET 32 (II-67)



SET 33 (II-68)

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Discussion

Evening (1800 - 2100) heart rates are higher than morning (0700-1000). Heart rates, evening blood pressures are also higher. The response to tilt for these two parameters did not show a difference at the two times.

The maximal increase in heart rate during tilt was 30% higher than pre-bedrest at 0 and 2-1/2 hours post-bedrest. The diastolic pressure tended to be higher pre-tilt and increased more during tilt resulting in higher mean pressures and narrower pulse pressures following tilt test. The maximum leg volume after 15 minutes of tilt was unchanged following bedrest, but the slope of the initial change in leg volume with tilt was 50% lower at 0 and 2-1/2 hours post-bedrest than during pre-bedrest or later recovery periods. These filling curves were digitized and the filling pattern at 10 seconds, 30 seconds and 3 minutes was significantly ($\alpha < .05$) lower at 0, 2-1/2 and 12 hours post-bedrest than during pre-bedrest. At 3, 5 and 7 days post-bedrest, the filling curves were still significantly lower at 3 minutes after tilt, but were significantly higher at 5, 10 and 30 seconds after tilt. The four students who were exercised during bedrest showed greater changes in the filling curve than the four who did not exercise.

The venous pressure tests showed changes in heart rate and blood pressure similar to the tilt tests, but to a lesser degree. Low volume increases were greater following tilt test.

The venous filling curves following blood removal or water immersion are consistently lower than pre-treatment values. The values obtained post flight in the Gemini series were consistently higher. These results following bed rest are dissimilar from those of either the simulations or the actual flight. The reason for the difference is not apparent.

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